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71st Congress, 2d Session | COMMITTEE ON RIVERS AND HARBORS, HOUSE OF REPRESENTATIVES U. S. | Document No. 47

CALOOSAHATCHEE RIVER AND LAKE OKEECHOBEE DRAINAGE AREAS, FLA.

LETTER

FROM

THE SECRETARY OF AGRICULTURE,

TRANSMITTING

REPORT OF AN INTERBUREAU COMMITTEE REGARDING AGRICULTURAL CONDITIONS IN THE EVERGLADES OF FLORIDA, AND THE EFFECT ON THOSE CONDITIONS OF PROPOSED NAVIGATION AND FLOOD-PROTECTION IMPROVEMENTS

DEPARTMENT OF AGRICULTURE,
Washington, D. C., January 21, 1930.

Hon. S. WALLACE DEMPSEY,
House of Representatives.

DEAR MR. DEMPSEY: On June 6, 1929, you informed me that a bill had been reported by the Committee on Rivers and Harbors involving navigation from Lake Okeechobee to the Atlantic and the Gulf, and incidentally involving flood protection, which would require an expenditure of at least $4,000,000 by the Federal Government. You stated that before adopting the bill the committee desired to learn whether the lands which are to be provided with navigation and with protection against floods have a value sufficient to justify the contemplated expenditure, and requested that an investigation be made which would yield information on the following topics:

1. The acreage which will be benefited through navigation and flood control by the proposed project:

2. The value of this land, involving—

(*a*) Whether with drainage and flowage, both of which would be provided by the contemplated project, the land is fertile and productive.

(*b*) The kinds of crops which will be produced.

(*c*) Whether the crops which can be grown are of value to the rest of the country.

(*d*) The relative advantages of this land as compared with other areas producing like crops as to transportation facilities and otherwise.

(*e*) The present market value of the land.

(*f*) The increase in the value of the land to be expected from the improvement.

(*g*) Whether the carrying out of the project will add taxable wealth to such an amount that the Federal expenditure will be repaid in taxes levied on these new assets.

(*h*) Any other facts which are deemed pertinent.

On June 14 I advised you that the information available in the department was not sufficient to justify an expression of opinion as to the agricultural possibilities of the region, and suggested that available data should be supplemented by a survey by a qualified board.

On June 17 you requested that the department have considered and determined by a board, the items submitted in your letter of June 6, and also the following:

3. How much the Everglades will benefit per acre, and in the aggregate by navigation and control of the water of Lake Okeechobee; and

4. What and how much more than now the Everglades will produce, once these improvements are made, stating the kinds of crops, their value, and their importance to the Nation?

On receipt of your letter the questions were referred to the following committee for consideration and a report:

Dr. A. G. McCall, Bureau of Chemistry and Soils, chairman; Mr. S. H. McCrory, Bureau of Public Roads; Mr. W. H. Black, Bureau of Animal Industry; Dr. L. C. Gray, Bureau of Agricultural Economics; Dr. E. W. Brandes, Bureau of Plant Industry; Dr. Victor R. Boswell, Bureau of Plant Industry.

Mr. E. W. Sheets, Bureau of Animal Industry, was originally appointed to the committee but owing to necessary absence was unable to serve.

The committee has given careful consideration to the data already available in the department and has supplemented this study by a field inspection of the area under consideration. Agricultural operations in the Everglades have been carried on for only a relatively short period of time and the records are not sufficient to permit of definite answers to all of your questions. Endeavor has been made, however, to comply as fully as possible with your request.

1. The acreage which will be benefited through navigation and flood control by the proposed project.

Navigable channels leading from Lake Okeechobee to ports on the Atlantic and Gulf coasts would make possible water transportation to ports on the North Atlantic coast for the produce grown in the Everglades. This service should be of considerable value to the lands tributary to the waterways. Flood-control works would be of greatest benefit to the lands immediately adjacent to the lake, but diversion of the flood waters from the lake to the sea through outlet channels would have beneficial effect upon that part of the Everglades lying south and east of Lake Okeechobee, thus making it necessary

350705

to provide outlets for only the surplus water that falls upon that portion of the Everglades.

2. The value of this land, involving—

(*a*) Whether with drainage and flowage, both of which would be provided by the contemplated project, the land is fertile and productive.

Sufficient data are not available to permit of conclusive answer to this question. Only a small part of the Everglades has been provided with adequate drainage and this only for a comparatively short time. This drained area includes a considerable portion of the best lands in the Everglades. The custard-apple muck and some of the intermediate soil types—which cover only a small percentage of the total area under consideration—have demonstrated their agricultural value for growing sugarcane, truck crops, and peanuts. If the recently introduced use of copper, manganese, and zinc as soil amendments should prove permanently successful, and climatic conditions suitable, the deep peat may be found adapted to the production of sugarcane, truck crops, and peanuts. The construction of the proposed improvements will make possible the orderly drainage of the Everglades under State laws, in units of any desired size and as rapidly as the economic need for these lands justifies their use for agriculture.

JAN 6 1932

(*b*) The kinds of crops which will be produced.

It has been demonstrated that sugarcane, certain truck crops, peanuts, forage crops, citrus and avocados can be grown on the superior soils in favored localities in the region under consideration. It remains to be determined whether these crops can be grown profitably in the saw-grass areas, particularly those not sufficiently protected by the moderating influence of Lake Okeechobee or the ocean. Further experimentation may show that the region is adapted to other special crops and possibly livestock.

James A. Brown

(*c*) Whether the crops which can be grown are of value to the rest of the country.

The United States is a large importer of sugar. Even if all of the land in the Everglades that might economically be used for sugarcane production were so employed. the sugar so produced would not be a large percentage of that imported. The ratio of domestic production to national consumption has decreased during the past decade due to failure of the growers to keep pace with the rapid increase in per capita consumption and the growth of population. The quantity of sugar likely to be grown in the Everglades could scarcely be more than sufficient to restore the previous ratio of domestic production to national consumption. The truck crops grown in the Everglades come on the market during the winter and meet keen competition from those grown in other parts of Florida, in southern Louisiana, southern Texas, southern California, Cuba, and Mexico. There is reason for apprehension that if extensive trucking developments are made within the Everglades in the near future, such an overproduction may occur that not only competing regions may suffer, but the new developments themselves may fail to reap a profit.

(*d*) The relative advantages of this land as compared with other areas producing like crops as to transportation facilities and otherwise.

Southern Florida is closer to the great industrial centers of the North Atlantic States than any other winter-vegetable producing area. Its railroad facilities are excellent. In addition, with the development

of deep-water ports in southern Florida, water transportation has been provided and is becoming of increasing importance.

(*e*) The present market value of the land.

(*f*) The increase in the value of the land to be expected from the improvement.

Sufficient information is not available to permit of a determination of the market value of the land in the Everglades. This varies greatly with the character of the soil, degree of drainage, and location. The assessed value of property in the Everglades drainage district increased from $9,690,800 in 1915 to $31,955,200 in 1928. A conservative estimate of the value of the custard-apple lands in their present condition is $250 per acre. If the entire area of custard-apple soils were protected against floods and provided with adequate drainage facilities, the average value probably would be above $350 per acre. The land values in the deep peat areas are still largely speculative. The Internal Improvement Board in 1909 sold these lands for $1.25 per acre. By 1910 the price had increased to $15 per acre, in 1913 to $15.45 per acre, while in 1926, the price averaged $108.66 and in 1928, $92.68. These prices were for raw land and represent the hopes of the buyers, rather than experience based on earnings of the land. There is at present no safe basis for forecasting how much the proposed improvements would increase the values of these lands.

(*g*) Whether the carrying out of the project will add taxable wealth to such an amount that the Federal expenditure will be repaid in taxes levied on these new assets.

The construction of the proposed improvements would undoubtedly aid materially in the development of this region and should result in a safer type of agriculture in the areas adapted to cultivation and some increase in the value of land and property benefited. Since local property taxes are not available as a source of Federal revenue, the prospect of direct reimbursement for amounts advanced appears remote. It is impracticable with the limited data now available to forecast how soon Federal expenditures might be offset by increased revenue derived from income taxes and indirect taxes.

3. How much the Everglades will benefit per acre, and in the aggregate by navigation and control of the water of Lake Okeechobee.

Such benefits are difficult to evaluate. It is probable that on those products which can be transported by water, the freight rates would be lower than those by rail. As more than 2,000 cars of vegetables are each year moved from that portion of the Everglades about Lake Okeechobee, the saving apparently would be an item of importance if a considerable proportion of these products were shipped by water. In addition, the same benefits would accrue on freight coming to points in the Everglades, and on freight from and to points on the waterways outside the Everglades. The frequency of tropical hurricanes which cause disastrous floods can not be predicted and there is no way of estimating the annual monetary benefits that protection from floods would give.

4. What and how much more than now the Everglades will produce once these improvements are made, stating the kinds of crops, their value, and their importance to the Nation.

Sufficient experience with the different soil types in the Everglades has not been had to permit a definite answer to this question. Such

conclusions of this nature as are now warranted have been given under topics 2 (a), (b), and (c).

It should be clearly emphasized at this point that the agricultural area in this and other countries is already overexpanded. There are more acres at work than are required to produce the agricultural products demanded at prices that are profitable to the majority of the growers. It appears to be a time for the exercise of great caution in expending public funds in such ways as will directly or indirectly stimulate the expansion of the cultivated area.

In order that your committee might have the benefit of such information as the department now has available, I asked the department committee to prepare a memorandum summarizing the data they have collected. I take pleasure in transmitting a copy of this report to you and hope that the information will be of some service to your committee.

Sincerely,

ARHTUR M. HYDE, *Secretary.*

MEMORANDUM REGARDING AGRICULTURAL CONDITIONS IN THE EVERGLADES OF FLORIDA AND THE EFFECT ON THOSE CONDITIONS OF PROPOSED NAVIGATION AND FLOOD-PROTECTION IMPROVEMENTS

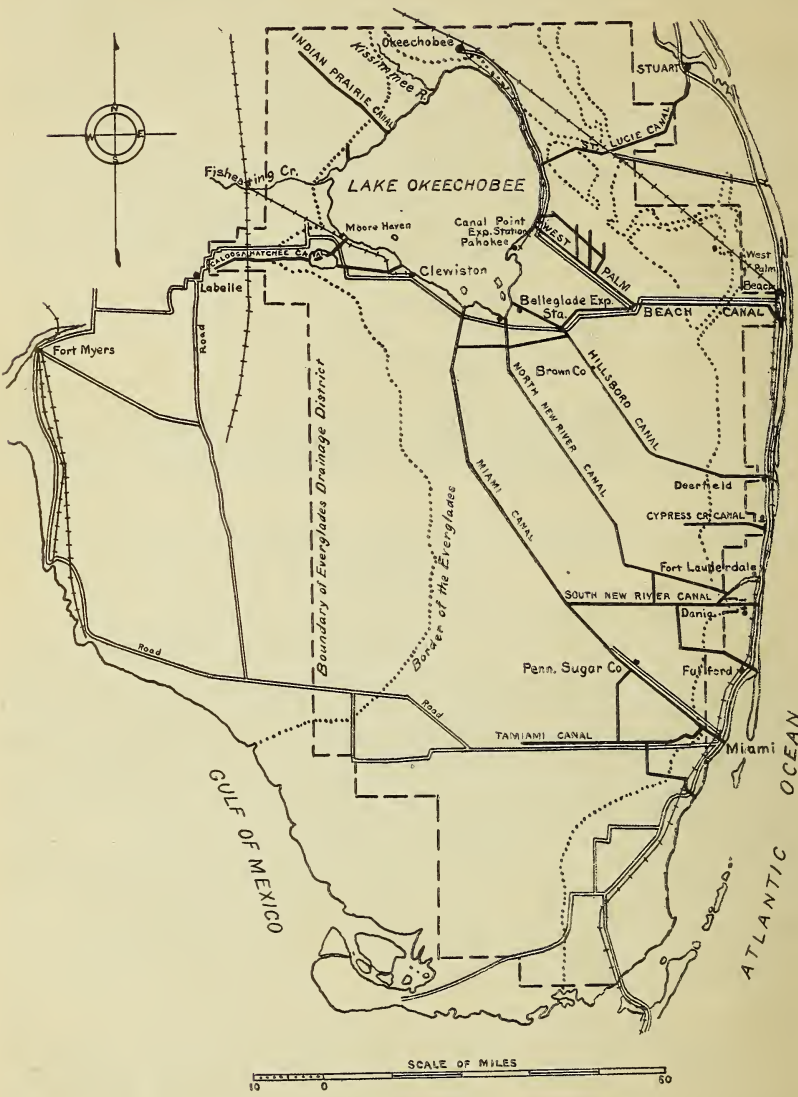
(Prepared by an interbureau committee appointed by the Secretary of Agriculture)

UNITED STATES DEPARTMENT OF AGRICULTURE,
Washington, D. C., January, 1930.

This memorandum presents the results of a study made by a committee appointed by the Secretary of Agriculture to supply information with reference to agricultural conditions in the Everglades section of Florida, as well as to the probable effect on those conditions of certain proposed navigation and flood-protection improvements. The information has been compiled at the request of Hon. S. Wallace Dempsey for use by the Committee on Rivers and Harbors. It represents a study of data available in the Department of Agriculture, as well as of the results of a field examination made by the committee in November, 1929. The views represented are those of the members of the committee, which was made up of specialists on the various agricultural phases involved in the Everglades problem, as follows:

Dr. A. G. McCall, Bureau of Chemistry and Soils, chairman; Mr. S. H. McCrory, Bureau of Public Roads; Mr. W. H. Black, Bureau of Animal Industry; Dr. L. C. Gray, Bureau of Agricultural Economics; Dr. E. W. Brandes, Bureau of Plant Industry; Dr. Victor R. Boswell, Bureau of Plant Industry.

Mr. E. W. Sheets, Bureau of Animal Industry, was originally appointed to the committee but was unable to serve owing to necessary absence.



EVERGLADES REGION OF SOUTHERN FLORIDA

To accompany memorandum of Committee of Department of Agriculture, Jan. 1930

EARLY EFFORTS AT DEVELOPMENT OF THE EVERGLADES

In 1845, through a joint resolution of the Legislature of the State of Florida, the attention of the Congress was called to the importance of examining and surveying the Everglades with a view toward their reclamation. The Secretary of the Treasury was instructed to make an examination and on August 10, 1848, submitted a report to the Senate. In 1850 the swamp and overflow land grant act was passed, and in 1851 the Legislature of Florida passed an act accepting the grant and creating the Internal Improvement Board to administer these lands. In 1881 some 4,000,000 acres of land in the Kissimmee Valley was sold to Hamilton Disston who began drainage operations on a considerable scale. Most of the works were located many miles above Lake Okeechobee. In an endeavor to control the level of the lake, one canal was constructed from the lake to the Caloosahatchee River, and one extending south into the Everglades without outlet. These operations ceased about 1889.

In 1902 Governor Jennings took up again the question of draining the Everglades and various legal and administrative questions were settled and a plan for drainage prepared. Governor Broward, his successor, secured the passage of a drainage law which was declared unconstitutional, but in 1907 an amended act was passed which was later sustained by the United States courts. Under the terms of this act, two distinct sources of revenue were provided for carrying on the work of reclamation: First, money derived from the sale of lands; second, a tax on the land included within the district. During the Broward administration the trustees constructed the dredge *Everglades*, which was launched on July 4, 1906, and the dredge *Okeechobee*, which was launched in October, 1906, and contracts were let for two additional dredges. Since that time the work of reclaiming the Everglades has been carried forward as rapidly as funds were made available. According to the biennial report of the Everglades drainage district, 1927–28, there has been expended to January 1, 1929, $17,926,103.20 on works for drainage, flood control, and navigation.

The cutting of the first canals from Lake Okeechobee to the south and east afforded a considerable degree of drainage to the lands adjacent to the canals, particularly when the locks were closed and the canals used only for drainage and navigation and not to carry water from the lake. Farming operations were begun on the custard-apple muck around Lake Okeechobee and at selected points on some of the canals, and good crops of truck were grown on some of these early developments. The clearing, cultivation, and drainage of the lands compacted the soil, oxidation began, and as a result the level of these soils gradually became lower. Moreover, fires in some places destroyed the dry top soil. On some of the well-drained, deep muck the subsidence amounted to from 3 to 4 feet. This phenomenon is not peculiar to the Everglades but is common to such soils throughout the world. The subsidence as it occurs decreases the degree of drainage available to these lands and renders them less satisfactory for cultivation. Thus it gradually became apparent to the interested landowners that additional drainage was necessary in a large part of the area that had been brought under cultivation, and subdrainage districts for the purpose of providing protection from overflow by means of levees, and of accomplishing improved drainage by sys-

tems of ditches and pumps, were undertaken. Later it was found that the pumps could also be used to advantage to bring water into the districts for raising the water table and thus subirrigating the lands during dry periods. It is only within the last two or three years that any considerable area has been provided with adequate drainage, lack of which has been the cause of many failures. At the time the committee inspected conditions in the Everglades (November, 1929) approximately 160,000 acres was provided with drainage by pumps.

In early stages of the development it was necessary to transport the crops grown in the Everglades by water to the railroad. Some years ago the Atlantic Coast Line Railroad extended one of its lines southward to Moore Haven, thus giving a rail outlet for the crops grown in that area. In 1928 an extension of this line around the south shore of the lake to Belle Glade was completed; thus a rail outlet for that section also was afforded. About the same time the Florida East Coast Railway extended its line from the town of Okeechobee southward through Canal Point to Belle Glade to join the Atlantic Coast Line, thus affording rail outlet to the area east of the lake. Recently deep-water ports have been constructed at Port Everglade near Lauderdale, and at Miami, and arrangements are now being made to convey part of the crops grown in this region by water to these harbors for shipment north by steamer.

A system of hard roads is gradually being extended through the Everglades, the main arterial highways already having been completed. Most of the land now in cultivation is within a comparatively short distance of an improved road. A number of small towns have sprung up about the lake.

CLIMATOLOGY

The value of weather records as a basis for generalizations upon the climate is almost in direct ratio to the length of the period of observation. In the Everglades proper authentic records of temperature and precipitation have been kept for about 15 years at two points—Ritta and Davie—and fragmentary records are available for several other points for shorter periods of time. Ritta is situated on the south shore of Lake Okeechobee and Davie is located on the South New River Canal at the edge of the Everglades, near Fort Lauderdale. Records have been kept for 10 years or less at Moore Haven and Canal Point, on Lake Okeechobee; Belle Glade, which is situated about 4 miles southeast of the lake; Shawano Plantation, 18 miles southeast of the lake; and Pennsuco, about 18 miles northwest of Miami. The Canal Point, Shawano and Pennsuco records are unofficial. In addition, unofficial records of temperatures have been kept for brief periods at other points; some of these are interesting in throwing light on the variation in minimum temperatures at different points during the same cold periods. Available temperature and rainfall records for various stations within the area under consideration have been compiled and are included herein as Table 1.

TEMPERATURE

In the matter of temperature—which is of special importance in connection with crops—it is safe to assume a certain relationship between that of the Everglades and those of other points in Florida,

TABLE 1.—*Florida temperature and rainfall records—Canal Point, Ritta, Moore Haven, Belle Glade, Pennsuco, Davie, Lock No. 1, Lock No. 4*

Year and month	Canal Point					Ritta					Moore Haven					Belle Glade					Pennsuco					Davie[1]					Lock No. 1, rainfall, inches
	Minimum temperature		Maximum temperature		Rainfall, inches	Minimum temperature		Maximum temperature		Rainfall, inches	Minimum temperature		Maximum temperature		Rainfall, inches	Minimum temperature		Maximum temperature		Rainfall, inches	Minimum temperature		Maximum temperature		Rainfall, inches	Minimum temperature		Maximum temperature		Rainfall, inches	
	°F.	Date	°F.	Date		°F.	Date	°F.	Date		°F.	Date	°F.	Date		°F.	Date	°F.	Date		°F.	Date	°F.	Date		°F.	Date	°F.	Date		
1914																															
January						35	5	81	9	1.10																36	1	87	10	2.54	2.93
February						15	21	85	7, 14	.57																36	17	89	7	3.94	3.65
March						34	10	89	31	1.41																27	3	86	21	4.49	1.33
April						56	1	91	10	5.03																49	16	93	20	7.62	8.00
May						58	16	92	13	.75																53	31	93	7	2.45	3.06
June						64	1, 5, 6	96	27	1.04																60	5	94	16	3.80	6.80
July						63	10	90	27	9.15																64	22	96	14	6.68	11.59
August						63	21, 22, 26, 27, 31	97	29	3.93																65	28	95	3	4.53	2.40
September						61	16	94	30	4.60																63	17	96	23	7.21	6.71
October										2.43																65	27	93	6	7.00	6.90
November										1.41																31	21	88	4	6.43	4.23
December						18	12	88	25	3.42																40	12	88	3	4.57	3.80
1915																															
January						35	14	83	18	3.00																				2.92	3.74
February						12	4, 8	84	1	4.94																37	8			2.62	2.75
March						38	18	87	31	1.03																35	19	88	31	1.63	1.61
April						39	5	87	20	2.18																				1.58	2.04
May						70	5, 6	90	7, 9, 27, 29	1.97																55	18	90	4	5.28	7.78
June						62	8			7.33																60	7	93	20	9.42	14.52
July						70	10	94	1, 5, 8, 15, 16	3.43																65	11	92	1[1]	11.62	8.46
August																												91	19	7.21	4.45
September																										67	21[1]	91	5	6.91	5.70
October																															14.56
November																															5.06
December						31	15	85	17	.63																					3.63
1916																															
January						55	3	81	6, 13, 22	.19																		83	17[2]	1.93	3.22
February						40	17, 25	86	2, 29	.25																32	28	85	29	2.37	1.57
March						38	15	91	2	.80																37	5[1]	88	22	.48	.58
April						44	10	88	7, 21	1.21																34	10	87	15, 26	4.49	3.81
May						53	1	95	22, 23	2.69																53	1	93	21	5.08	4.53
June						60	1	93	6	6.78																55	1	92	7	10.55	7.91
July						67	7, 21	96	21	7.03																65	18	91	19	6.35	6.17
August						67	7	97	17	4.23																65	5	92	1, 17	9.79	9.43
September						62	25	95	1	4.98																62	25	90	5, 8, 15, 17	7.44	
October						62	1, 22	91	6	4.20																58	1, 22, 23	90	7	5.32	6.66
November						41	29	86	9	2.38																39	20	83	10, 11	3.87	1.25
December						35	17	87	26	4.39																33	16, 17	86	22	.63	.60
1917																															
January						36	12	86	24	.81																32	12	83	3, 25, 30	.12	.10
February						29	1	91	18	.65																21	6	80	20	.22	.85
March						51	20	92	21	1.03																44	19	85	4, 26	3.30	3.39
April						40	7	94	30	.13																29	7	86	6	2.08	3.18
May																										46	16	93	24	3.29	2.36
June																										63	2, 4, 10, 12, 13	92	24	6.50	7.45
July																										62	28	94	10	3.68	5.97
August																										62	4, 6, 9	95	10	1.98	7.75
September																										65	13, 17	95	21, 22	9.76	5.20
October						62	23	92	14	1.25																59	25	91	30	5.64	6.59
November						37	25	83	13, 29	.36																34	25	83	30	.55	.57
December						30	10	82	8	.16																25	10	86	8, 13	2.01	.90
1918																															
January								86	28	1.99																23	4	87	17	.81	.90
February								87	10	2.25																34	5	88	20	2.11	1.67
March						51	5	87	7, 14, 15, 17, 19, 31	2.75																47	22	92	31	5.06	4.30
April						45	12	91	21, 24, 25	2.97			90	20[1]	2.03											35	13	93	4	6.90	3.22
May						66	5	90	30	.93	58	10	93	31	.35											51	9	92	18	3.79	4.61
June						63	2, 12	93	13, 30	3.60	63	1[1]	91	5[1]	2.55											60	8	95	28, 29	7.58	7.05
July						67	15, 21, 29	95	20	3.13	64	28	95	20	2.67											65	15, 28, 29	94	1, 9, 14	7.56	6.74
August						67	9	98	15	7.06	65	9	98	15	6.94											66	10, 14, 15, 23	96	15	3.27	2.55
September						60	15	91	7, 12	4.64	61	15	91	7[1]	10.83											64	5, 6, 15	94	8	9.93	10.50
October						65	24	93	14	5.39					2.72											66	9, 25, 29	89	22	7.58	7.58
November						44	20, 21	88	24, 28, 29	.20			87	29	.95											46	21	87	30	.61	1.05
December						41	29	88	11	.16					.73											35	29	85	1	3.05	2.73
1919																															
January						39	8	85	23	.05			86	24	1.25													85	24	1.21	1.32
February						36	11	86	22		32	17	87	22	3.70													84	22, 23	2.62	3.46
March						51	31	88	6, 14		44	21[1]	90	6[1]	2.53													89	9	8.21	9.51
April								92	17		42	6	91	16	.62													90	26	8.32	8.49
May						54	22	94	19	6.14	52	22	92	1[1]	6.70													90	13	7.18	8.45
June						65	16	94	30	6.62	62	15	93	30	10.59													92	29	7.94	11.52
July						68	28	92	9, 11	4.33	66	2[1]	92	1[1]	6.68											67	2, 20, 31	93	5	6.79	6.77
August						69	7	90	16	4.14	64	29[1]	95	6[1]	4.12											66	25	94	4	6.53	5.44
September						64	30	91	1	10.81	65	30	93	1[1]	2.78											67	24, 23, 30	90	4, 7, 18, 24–27	7.07	5.29
October						60	25	93	2	.94	63	29	90	3	.90											63	25	88	1–4, 9, 10, 14	4.67	5.87
November						46	19	88	2, 3	1.09	41	19	90	1	1.60											42	19	89	2	1.95	2.75
December						36	30	83	10	1.47			85	21	1.15											20	30	84	2	1.53	1.18
1920																															
January						37	5	84	15, 25, 26	.18	23	4	87	25	2.10											20	4	84	17, 25	.51	.52
February											33	9[1]	85	12	2.70											30	17	86	13, 14	2.01	1.98
March						30	7	95	28	3.40	25	2	92	25, 30	.53											25	2	88	30	2.07	.63
April						44	6	93	2, 21	3.57	39	6	93	1, 26	3.13											37	6	90	4, 17, 28	4.98	4.12
May						60	4	93	13	1.61	55	25	93	14	3.05											57	23	91	14	3.13	7.65
June						62	13	95	17		56	13	91	11	6.94											59	12	91	16	4.70	5.55
July						62	24	91	1	9.22	60	23	94	4, 5	15.21													93	4	5.81	7.20
August						63	16, 17, 22	92	24, 25, 27, 29	4.08	67	30	94	25	4.51											65	17, 23, 24, 25	92	24, 25, 30, 31	7.81	9.63
September						61	6, 8	92	4, 9, 14	5.72	65	7	96	3, 14	1.18											65	1, 14, 17, 15	93	1, 4, 10, 13, 14	10.56	9.35
October						54	1	86	26, 27	1.20	43	1	87	20, 27	2.72											54	1	87	28	6.73	3.98
November						47	24	87	14	2.69	40	24	85	21	1.10											47	25	86	3, 22	5.41	6.12
December						34	17	84	26	1.64	32	17	86	23, 27	.43											30	17	87	5, 23	1.45	.90
1921																															
January						36	16	84	5	.30	37	16	85	14	.15											29	16	85	3	1.23	.70
February						37	23	86	20	.59																31	25	88	6, 7, 10	1.47	1.26
March						51	1, 4	88	13	.79																45	4	89	18	4.92	4.91
April						51	12	91	17	.25																40	12	90	10, 23	1.94	1.96
May						41	6	93	29	5.65																42	8	93	30	2.44	1.89
June						41	14	97	22	1.20																60	15	95	20	1.32	2.29
July						65	18, 30	94	1, 20	4.07																65	7, 21, 26	91	5, 17, 21, 22	7.02	7.64
August						64	10	96	13	1.70																64	18	91	17, 18, 19	2.97	3.60
September						67	6, 7	92	3, 5, 7, 10	1.05																62	8	93	7	2.33	2.49
October						65	9, 12	90	2, 5	13.67	62	5, 12, 21			8.35											64	5, 12, 31	91	3	21.31	20.64
November						45	13	85	14	1.23	37	13			2.19											47	30	89	9	2.36	2.68
December						40	12	84	4	.00	37	6	85	4	.23											36	12	88	3	.81	.61
1922																															
January						35	13	82	25	.65	31	13	85	20, 21	.70											30	13	82	19	2.32	2.57
February						42	8, 9	86	5, 6	.72	32	17	87	5, 6	1.10											36	8	89	6	3.10	1.19
March						47	24	90	15	.00	37	21	89	7, 11	.71											45	23	89	11	.41	.40
April						67	28	93	11	.71	48	23	92	13, 18, 29	.16											53	23	91	12, 29	1.45	2.01
May	61	1	101	15	8.69	69	10	94	10	11.15	68	19	96	15	5.14											55	10	92	18	12.33	9.02
June	67	10, 11	101	14, 19	6.80	65	10	94	14, 20	7.09	62	8	95	13, 14	9.82											61	11, 13	90	14, 18, 19	12.39	11.04
July	68	29, 30	98	25	6.43	68	14, 30	92	4	4.21	61	30	94	24	7.13											65	7, 31	92	23	9.71	15.10
August	67	10	95	1	9.41	68	11, 15	91	3	7.58	68	6, 31	91	2	6.72											65	2, 5	94	3, 6	13.71	13.98
September	65	21, 22	92	9, 10	11.77	67	22	94	13, 16	11.42	64	22	93	13, 16	14.04						58	22	100	9	9.78	68	7, 13, 23, 24	91	13	13.40	15.86
October	66	11	90	1, 8	6.61	65	11, 27, 28	90	9	13.29	64	11	91	5, 6	10.70						68	11	90	23	13.73	65	21	91	1, 6	13.65	13.85
November	52	26	85	1	3.20	64	27	85	15	.18	51	26, 29	84	1	1.56						52	29	87	1	3.91	47	29	88	1, 6	7.51	6.14
December	41	22	85	11, 17	.62	51	21	89	16, 18	.35	41	23	87	17	.59						15	22	89	13	.20	43	23	87	10	1.54	.93
1923																															
January	41	16	85	22, 31	1.53	47	17	87	31	.25	36	17	82	2	.32						32	17	88	21	.00	36	17	83	3[1]	.27	.10
February	44	18	87	13	1.63	49	18, 19	90	13	1.09	38	17, 19	87	8, 13	.19						36	17	90	11	.75	38	17	87	6	1.12	1.30
March	46	3	90	30	.34	51	3	92	30	.37	44	3	88	30	.62						45	2	93	1	3.41	45	2[1]	88	29	1.77	
April	61	2	93	29	2.01	60	22	93	6	2.27	53	25	91	5	3.35						52	6	100	21	1.26	47	19	92	29	3.12	
May	49	12	95	16	7.06	52	11	96	13	9.63	48	10	90	16	11.70						46	11	98	21	6.37	48	11	90	16[1]	8.08	
June	64	2	95	13	6.62	65	2	96	11, 12	5.59	65	1, 2	93	12	12.52						60	1	101	30	7.68	60	1	94	20[1]	10.70	
July					8.48	67	1	95	10	10.45	67	1	93	30	7.54						63	14	101	16	7.54	65	1	93	17	9.07	
August	61	3	87	13, 14, 18, 29	9.95	69	3, 5	93	16, 23, 25		66	12	93	12, 23, 24	10.04						61	2	99	14	8.27	63	16	91	13[1]	5.97	
September	61	30	87	10	8.31	71	1, 9, 12	93	22	4.16	63	3, 29, 30	91	7, 9, 10	1.20						57	30	97	6	6.35	63	9	94	9[1]	4.72	2.39
October	52	24	83	1, 2, 3, 4	3.17	65	21	90	5, 8, 19	3.08	43	24	90	3	1.59						37	23	98	5	2.95	10	25	93	4[1]	4.89	3.55
November	36	18, 19	83	27, 29	.41	46	19	87	27	.15	33	18	85	27, 29	.21						34	18	91	5	.58	37	18	85	5[1]	1.15	.80
December	44	7, 24	82	21	.45	53	6, 7	85	30	.63	33	25	85	31	.24						40	6	83	11	.52	39	7	84	15[1]	1.09	4.57

[1] Zero in January, 1914.

[1] Also on other dates.

[3] Lock No. 4.

TABLE 1.—*Florida temperature and rainfall records—Canal Point, Ritta, Moore Haven, Belle Glade, Pensuco, Dania, Lock No. 1, Lock No. 4*—Continued

Year and month	Canal Point: Minimum temperature °F.	Date	Canal Point: Maximum temperature °F.	Date	Canal Point: Rainfall, inches	Ritta: Minimum temperature °F.	Date	Ritta: Maximum temperature °F.	Date	Ritta: Rainfall, inches
1924										
January	41	6	83	1	3.09	18	6	83	17	4.27
February	35	3	79	18, 16, 25	2.23	45	8	82	19, 25	2.10
March	37	13, 23	85	31	3.71	38	19	85	6	1.85
April	46	9	91	18	2.17	56	9	94	18	2.60
May	52	11	94	28, 30	2.27	58	11	95	28	2.58
June	61	10	93	3, 1	1.84	66	18	96	3	3.51
July	63	3, 4	91	26	11.08	69	29	95	19	8.02
August	65	6	95	12	1.85	70	11	90	12, 25	1.61
September	62	5	92	16	10.97	69	3, 6, 7, 10, 20	95	3	8.06
October	62	16	86	3, 10	18.14	67	28	81	1	16.67
November	49	30	78	1	.89			80	21, 24	.21
December	11	13	82	24	.15	50	1	85	25	.02
1925										
January	43	27, 30, 31	82	11, 17	6.10			83	17, 19, 22	1.91
February	37	13	84	17	2.21	40	13	81	17	1.53
March	12	25	85	17	2.16	46	31	86	19	1.37
April	43	1	88	29	3.52	15	2	87	28	4.27
May	47	2	89	4	9.73	58	2	88	27	15.87
June	50	7	89	20, 23, 24	8.62	65	6, 27, 23	92	10	7.93
July	60	1, 6	87	1, 10–12	.96	67	17	93	31	12.67
August	65	9	91	14, 20, 26	7.12	60	5	93	26	0.29
September	51	21	92	23, 26, 28	4.09	71	21, 25	95	10	1.86
October	15	23	96	26	2.25	55	23	91	17	1.85
November	35	25	89	7	1.87	38	21	86	12	1.33
December	35	4	92	15	1.99	39	27	81	14	1.78
1926										
January	32	11	95	6	6.19	31	15	87	22	4.11
February	37	11	84	4, 18, 25	2.25	40	12	84	15, 18, 25	1.99
March	38	14	86	31	1.71	37	15	87	30, 31	1.21
April	60	18	90	12	3.33	19	17	88	13	2.65
May	52	18	91	11, 27	1.60	54	16, 17	88	10, 11, 20	2.43
June	55	2	94	20–21	8.62	65	2	93	23	5.67
July	56	7, 21	95	13	7.54	65	2, 3, 7	93	12	13.67
August	60	5	98	7	5.82	64	27	93	6, 7	8.59
September	60	16	95	2	11.78	72	9, 17, 20	92	2, 3	
October	56	26	88	3–6	1.21	66	27	91	6	2.15
November	19	20	86	3	.72	51	20	87	9	1.47
December	42	30	81	22, 26	.16	35	31	85	22	.19
1927										
January	33	3	82	23	.33	33	2	82	14	.43
February	44	21	86	13, 11	1.80	42	22	85	12, 11	2.32
March	42	3	87	22	2.37	41	3	80	21, 22	3.13
April	51	1	89	30	1.08	53	9	87	29, 30	1.22
May	51	19	97	28	1.54	47	17	92	23, 25, 31	1.82
June	64	20	98	16	6.31	65	1, 4, 6	95	14	6.81
July	65	1	95	3	7.32	66	1, 11	96	2	7.30
August	64	8, 27	95	18	8.11	64	20	95	11, 12, 18	7.85
September	67	15, 22, 25, 26	93	14	3.31	67	16, 22	92	18, 20	10.15
October	52	19	95	3	3.35	45	21	91	3, 17	2.91
November	38	5	85	2	.19	39	5	81	3, 16, 30	.08
December	40	21	85	1	.40	30	22	81	16	.29
1928										
January	33	12	82	25	.16	32	29	84	25	.34
February	38	19, 28	89	25	1.38	37	29	89	25	.47
March	43	4	92	11	3.48	39	21	91	30	1.09
April	38	29	89	15	1.72	11	20	90	15	2.15
May	48	11	91	20, 28	3.16	42	10	92	20, 28	2.85
June	57	8	95	20	6.42	61	9	93	6	7.81
July	66	6, 7	97	28	14.67	67	6, 7	95	28	8.68
August	67	7, 17, 18	96	23, 24	11.13	68	18	94	16, 17	11.59
September	68	4	93	28	16.45					
October	60	24	92	4	.77					
November					1.21					
December	33	29	83	2	.20					
1929										
January	40	31	86	25	1.31					
February					.17					
March	11	6	91	28	.60					
April	47	19	92	22, 29	2.35					
May	48	3	93	1	6.67					
June	63	11	92	30	11.82					
July	65	29	93	1, 2, 3	11.12					

Year and month	Moore Haven: Minimum temperature °F.	Date	Moore Haven: Maximum temperature °F.	Date	Moore Haven: Rainfall, inches	Belle Glade: Minimum temperature °F.	Date	Belle Glade: Maximum temperature °F.	Date	Belle Glade: Rainfall, inches
1924										
January	41	6	81	11	3.05					
February	33	10	83	21	1.75					
March	31	12, 13	89	31	3.38					
April	51	8	91	15	3.55					
May	52	3	95	27	1.21					
June	61	10	95	2, 3	8.56	65	9[1]	97	3	1.83
July	65	31	92	19	11.77	66	12, 29	91	17	6.59
August	65	4	93	8	4.76	68	6	98	9	3.72
September	63	5	92	15	8.43	61	3, 5	95	4	8.19
October	58	19	85	4	13.39	63	3, 11	89	6	15.84
November	11	30	80	6	.30	15	30	80	5–13	.62
December	11	12	81	8	.57	45	13	81	20	.22
1925										
January	49	31	87	16	2.21	55	4	84	18, 19	3.58
February	32	13	81	16, 17	1.88	33	13	84	18	2.10
March	37	6, 7	88	17, 19	2.04	36	7	80	21	2.37
April	38	2	88	20	3.92	35	2	80	30	2.78
May	61	2	91	26	6.43	15	3	91	13	9.38
June	67	7	93	20	8.69	61	2	92	29	5.61
July	68	17	95	29, 31	1.68	65	4	95	28	5.56
August	69	4	93	4	9.83	68	1	95	21	12.36
September	70	19, 23–25	91	5, 6, 19	3.08	62	24	91	6	4.17
October	48	24	92	26	1.51	51	23	91	8	.49
November	36	25	88	1	.46	33	21	85	3	1.14
December	30	27	85	15	2.83	41	27	87	18	2.64
1926										
January	34	15	85	22	3.19	25	15	87	21	5.39
February	35	12, 13	89	19, 23	1.10	31	12	84	19, 20	.66
March	31	17	89	30	1.12	31	15	88	31	1.48
April	17	17	90	12	3.82	45	16	91	13	1.81
May	22	17	93	11	2.13	59	17	91	12, 13, 15	3.72
June	38	2	95	20	15.05	54	2	93	21	9.29
July	69	1–3, 5, 18	96	11	11.21	66	7	95	13	10.57
August	69	27	94	7	6.24	68	27	95	6	10.50
September						63	14	93	3	13.60
October						52	26	90	7	3.58
November						47	20, 21	88	9	.91
December	31	30	84	21	.10	33	31	85	21, 27	.55
1927										
January	30	12	82	7	.11	26	12	81	15, 31	.32
February	13	22	88	12, 14, 16, 21	2.09	42	22	85	15, 17	2.90
March	30	4	89	23	1.70	31	4	88	23	2.18
April	55	1	91	10	2.02	61	1	88	5, 7	2.11
May	49	17	96	27	1.91	46	17	93	12, 29, 30	3.19
June	66	1	101	1	10.79	61	6	97	16	7.08
July	68	1, 11	98	1, 2, 3	5.79	63	1	96	3, 4	12.77
August	65	20	97	13	5.61	61	28	96	7, 19	11.15
September	65	30	94	14, 20	6.99	65	22	94	21	6.41
October	42	19	98	3	4.12	45	19, 20	85	1	1.52
November	40	5	89	1	.38	37	5	87	2	.11
December	25	21	85	1, 16	.30	29	21, 31	81	2, 17	.12
1928										
January	25	29	84	21	.13	27	29	83	16, 10, 27	.31
February	33	19	91	21	2.31	30	19	92	23	1.60
March	37	22	94	29	2.16	38	22	93	30	3.83
April	39	29	90	21	1.52	38	29	91	16	1.78
May	15	9, 10	95	28	4.19	44	6, 10	94	29	2.01
June	63	20	95	6	8.12	59	9	91	22	6.21
July	68	1, 5	98	25, 26, 28	5.43	67	1, 6, 7	95	28	8.11
August	70	7, 17	95	22, 23, 21	11.82	68	22	94	4, 20, 21, 25	11.32
September	65	20, 21	94	1	14.60					18.54
October	51	25	90	4	.17					1.10
November	32	22	89	7	.07	13	22	86	8	1.07
December	33	26	87	3	.31	33	29	88	3	.25
1929										
January	31	13	89	25	.82	35	13	89	20	1.20
February	36	14	61	19	.34	36	11	89	11	.19
March	37	6, 7	94	23	.52	30	7, 8			1.71
April	42	18	95	29	1.55					2.61
May	17	4	97	1	2.73	50	4	90	1	8.92
June	64	1, 8	95	30	6.35	62	2, 7	92	25	11.11
July	66	8	95	3, 4	8.11	62	31	94	2, 17	7.32

Year and month	Pensuco: Minimum temperature °F.	Date	Pensuco: Maximum temperature °F.	Date	Pensuco: Rainfall, inches	Dania: Minimum temperature °F.	Date	Dania: Maximum temperature °F.	Date	Dania: Rainfall, inches	Lock No. 1, rainfall, inches
1924											
January	48	1	89	10	2.00	47	6	87	11[1]	1.11	6.33
February	30	8	88	20	2.71	32	11	81	20	2.57	2.05
March	32	12	88	7	1.24	32	12	92	31	.84	.92
April	51	13	96	27	2.37	50	8	92	13	4.16	3.81
May	54	2	103	23	5.40	55	3[1]	91	26[1]	3.68	6.68
June	59	3	100	11	2.95	62	10	91	2[1]	8.91	6.93
July	63	30	98	9	5.75	66	17	97	17	6.53	8.65
August	64	29	103	8	5.17	65	16[1]	97	11[1]	2.30	2.27
September	57	17	95	4	10.53	65	3[1]	95	3	10.92	12.70
October	61	3	97	25	17.75	65	3	90	10	27.07	28.16
November	17	30	102	4	.81	45	30	82	8[1]	.61	.56
December	16	1	98	21	.47	38	14	80	25	1.40	.93
1925											
January	52	31	99	2	4.93	51	31	88	1	10.13	11.51
February	38	12	93	27	3.80	33	13	84	17[1]	1.73	1.63
March	35	6	92	14	3.15	42	7	86	9	5.76	7.28
April	42	2	95	16	1.72	38	1	89	20	2.28	2.14
May	65	18	97	24	16.15	50	3	91	14	16.63	13.25
June	61	9	96	27	6.17	63	20	92	20[1]	6.09	5.32
July						65	20	94	27	1.13	5.88
August						67	16	95	1[1]	8.00	7.29
September						63	24	93	22[1]	3.67	2.28
October						45	23	94	6	3.52	2.67
November						37	21	87	2[1]	11.05	
December						38	27	87	17	.93	
1926											
January						26	15	90	22	6.27	
February						30	12	90	26	1.49	
March						37	16	91	31	.08	.12
April						42	17	92	12	2.08	3.29
May	50	17	92	3, 9, 11, 23, 25		50	17	94	11	7.56	7.39
June	61	1	102	20		56	2	95	22	9.11	7.76
July	72	2, 22	96	25	7.04	65	8	93	15[1]	9.75	10.15
August					12.13	68	15	95	6[1]	12.08	10.76
September					15.35						
October					9.78						
November					2.91						
December					.29						
1927											
January					1.61						
February					2.03	40	22	89	21	3.47	
March	33	1	90	10, 22	.71	32	1	90	22	1.08	
April	52	1, 8, 10	90	2, 11	2.61	50	16[1]	90	1[1]	5.94	
May	40	18	95	29	.30	47	17	93	11[1]	1.12	
June	61	12, 24	97	20	5.21	64	3	94	2[1]	5.62	
July					6.00	66	3[1]	97	2	9.21	
August	61	28	96	13, 11	11.00					8.78	
September	67	18, 23	95	19	7.42	67		94	20	10.42	
October	48	19	91	13	5.62	43	20	93	3	5.89	
November	41	5	87	1	2.51	13	5	87	2	2.18	
December	33	21	85	1, 8, 19	.58	31	22[1]	85	16	1.70	
1928											
January	24	29	67	25	.40	23	29	86	23[1]	.97	
February	34	19	92	25	1.31	36	19	90	25	.62	
March	39	19, 22	90	10, 20–30	2.01	37	22	91	20	2.64	
April	38	29	92	15	1.65	35	29	92	15[1]	2.20	
May	50	9	96	21	0.99	44	9	91	21	5.88	
June	65	7	91	23		63	17	90	6[1]	8.32	
July						65	25[1]	92	29[1]	2.15	
August					13.76	66	17	89	11	18.43	
September					11.76	68	4[1]	98	1		
October					3.83	58	25	87	20	5.62	
November					1.15	12	23	88	8	2.13	
December					.78	32	29	87	2	3.48	
1929											
January					.20	39	13	85	20	1.70	
February	43	11	88	10, 16, 22, 28	1.49	10	14	86	10[1]	.82	
March					4.35	35	7	88	1	1.59	
April					3.09	47	17	89	22	3.15	
May						57	17	89	1[1]	3.80	
June					10.13	63	1	91	30	7.35	
July					11.99	64	1	94	2	12.98	

[1] Also on other dates.

and fortunately the temperature records for Florida cover a long period of time. These records are sufficient to disprove the statements so often heard regarding the severity of recent cold spells, which according to some residents and others are unprecedented. For example, the cold of January 2, 1766, was reported not only to have killed the tropical vegetation in the vicinity of St. Augustine, but also to have severely injured maples, elms, etc. In 1766 a snowstorm covered most of northern Florida. On February 8, 1835, the St. Johns River was frozen for several rods from shore when the temperature stood at 7° above zero. Epochal freezes of more recent date—fatal even to citrus groves in parts of Florida—occurred in December, 1894, February, 1895, and February, 1899. In February, 1917, the temperature dropped to 27° as far south as Miami on the east coast, and to 29° at Ritta, the temperatures at St. Augustine and Jacksonville on the St. Johns River being 18° and 16°, respectively, on the same date. During some of the earlier and more severe freezes, of record in the neighborhood of St. Augustine and Jacksonville but not in the Everglades, it seems probable that the same general ratios of temperatures obtained and that temperatures lower than any on record have occurred in the Everglades. Such freezes are unusual, however, and in connection with agriculture only need be taken into account as hazards of infrequent occurrence.

Frosts injurious or fatal to the more tender vegetation occur at one point or another in the Everglades practically every year. They occur only at night and generally the period of cold is very short and is followed by a sudden rise in temperature. It is this rapid rise of temperature after the interval of cold in this region that causes injury to plants.

It is well established that conditions resulting in frost are clear, still nights with the dew point below 32° F. The clear winter nights favor rapid radiation and the black peat soils of the Everglades radiate heat more rapidly than do the sandy and marl soils surrounding them. These conditions result in lower temperatures in the Everglades than at the coast in the same latitude. The moderating influence of the water—in giving off heat slowly—also affords added protection to the coastal areas as compared with all except a small portion of the Everglades. The exception is the area immediately adjacent to Lake Okeechobee. The influence of the Lake is very marked but extends for only a short distance from its shores. It is noteworthy that, according to the testimony of residents of the islands of Ritta and Kreamer, no freezing temperatures have occurred in their experiences. This is partly supported by the private thermograph records of a vegetable grower on Kreamer Island, which show no temperature below 48° in February, 1925, although at Canal Point, 8 miles away, the temperature dropped to 37° and at Davie to 32° in the same month. In the absence of authentic temperature records such observations and data are presented for what they are worth. The only justifiable deduction is that the data tend to establish as a fact what theoretically would be expected, namely, that islands in the Lake benefit to the greatest extent by reason of the moderating influence of the water.

In contrast with most regions in the Temperate Zone, the "growing season," or the period between the last killing frost in spring and the first killing frost in autumn, is of comparatively little significance

in the Everglades. The two main agricultural activities at present—winter-vegetable growing and sugar cane culture—are carried on during the period when frosts occur and the question is not "When is it safe to plant?" but rather "Is it safe to plant at all?" In reference to most winter vegetables commonly grown it must be recognized that no part of the Everglades is immune from frosts disastrous to them during the months of December, January, February, and even November and March. A few growers are now unwilling to risk the vicissitude of the weather and have taken steps to give their crops some measure of protection, such as installation of heaters or overhead-irrigation systems, but the bulk of them still gamble on the weather, often with consequences fatal to their enterprises. The successes in bringing a crop to harvest outnumber the failures, even where no precautions are taken, but the opinion prevails that the failures due to frosts are too numerous and that protective measures of some kind are warranted.

In these remarks most attention has been given to low temperatures, as from the standpoint of agriculture in this region they are the more critical of the two extremes. There is no official record of a temperature as high as 100° at any of the Everglades stations, although unofficial records for Pennsuco have exceeded this on four occasions, all during the summer of 1924.

The mean maximum and minimum temperatures by months for Moore Haven and Ritta for the entire period of observation are presented in Table 2.

TABLE 2.—*Maximum and minimum observed temperatures in °F. at Moore Haven and Ritta, Fla.*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Moore Haven:												
Maximum	74.7	75.0	79.2	83.9	86.3	89.0	89.5	90.3	88.5	83.2	77.7	76.4
Minimum	53.7	51.8	55.0	59.3	63.9	68.5	70.1	71.0	69.7	67.7	59.6	56.0
Ritta:												
Maximum	74.2	75.5	78.3	83.0	85.3	89.0	89.8	90.0	87.8	83.3	76.6	75.2
Minimum	56.4	55.2	57.8	61.5	65.3	69.4	71.1	71.7	72.0	70.1	62.1	57.5

These figures indicate quite clearly the natural climatic advantages of the region so far as temperature is concerned. It is not necessary to dwell upon the fact that except for the brief periods of cold that occur at irregular times in winter, the temperatures prevailing in this region are not to be regarded as limiting factors in crop production at any time.

PRECIPITATION

There is a marked seasonal distribution of rain in the Everglades. The wet season extends from May to October and the winter months are dry. The average annual precipitation is between 40 and 50 inches. There have been years when 70 inches and probably more have fallen. Conditions of drought have been reported, but they are infrequent and as a rule not serious. At Canal Point periods up to 90 days with between 1 and 2 inches of rain have been experienced twice since 1922. Strata of ash in the peat deposits record the occurrence of great fires hundreds or even thousands of years ago. The Seminole Indians have a legend that the country "burned up" long

ago. These fires must have followed periods of prolonged drought. Droughts of such severity must be so rare as to be practically negligible.

The intensity of rainfall during the tropical storms is remarkable; as much as 18½ inches have been reported in 24 hours, and 1 inch in 5 minutes. The average number of rainy days in southern Florida by months is as follows:

January, 8; February, 7; March, 5; April, 4; May, 8; June, 12; July, 13; August, 15; September, 16; October, 12; November, 8; December, 7.

Fog occurs rather frequently during the winter months, especially in the vicinity of Lake Okeechobee. The fog forms at night and as a rule is dispelled shortly after sunrise. The number of sunny days and the intensity of sunlight in winter are great and in consequence the rate of evaporation is high.

Storms.—Southern Florida is in the path of the destructive windstorms known as hurricanes which originate in the Atlantic Ocean north of the Equator and move northwestward toward the North American Continent. These storms are characterized by extremely high wind velocities and torrential rainfall. Attention has been centered upon the Everglades on account of the great loss of life which occurred there during the hurricanes of 1926 and 1928. Most of the deaths were caused by drowning when the waters of Lake Okeechobee were forced over urban and other populated areas near the lake by the tremendous force of the wind. While these storms are not frequent in this area they are a constant source of danger to life and property. The flat surface features of the lands surrounding the lake, extending for many miles and comprising the most densely populated portion of the Everglades, adds to the menace and presents a problem that should receive immediate and intensive study with a view to preventing repetition of the disasters so fresh in the minds of all.

FLOOD CONTROL, DRAINAGE, AND IRRIGATION

Agriculture in the Everglades has been greatly hampered by the lack of adequate drainage for the lands in cultivation. The development of a successful agriculture in this region is dependent upon:

(1) Control of the waters of Lake Okeechobee.

(2) Provision of adequate drainage for the lands that are cultivated and to be cultivated.

The control of the waters of Lake Okeechobee requires the provision of outlet canals with a minimum capacity of 7,500 cubic feet per second when the lake is at elevation 17, and the construction of a levee to hold the water within the lake when tropical hurricanes strike the region. The St. Lucie Canal now affords outlet for 5,000 second-feet, and it is desirable that provision be made for discharge of at least 2,500 second-feet additional through the Caloosahatchee River or by enlarging the St. Lucie Canal. It is quite possible that the development of the lands along the Kissimmee River above Lake Okeechobee at some future date may increase the rate at which water is discharged into the lake, and require still further increase in outlet capacity. The provision of adequate outlet canals to carry the flood waters from the Kissimmee River and Lake Okeechobee to the sea, would make possible a closer regulation of the lake during periods of heavy rainfall.

Construction of a levee about Lake Okeechobee to confine the storm tides is essential to the security of the inhabitants of the region and should be undertaken at an early date. Such a levee would prevent the water of the lake from spilling over its south rim and from flooding the Everglades when high storm tides occur, and thus would relieve the drainage canals in the Everglades south of the lake from the necessity of caring for flood waters spilled from the lake and make it possible for them to afford drainage at all times to the land they serve. The control of floods would be of greatest benefit to the lands lying close to Lake Okeechobee, but would have a beneficial effect upon the entire area of deep muck by reducing the amount of water that ditches are required to remove during great storms.

The drainage of the Everglades will require the construction of outlet canals to carry water from the drained area. It will not be possible to secure satisfactory drainage for the greater part of the Everglades by gravity and it will accordingly be necessary to pump the drainage water from the lands adjacent to the canals. Probably the most economical procedure will be to place the main outlet drains approximately 6 miles apart and to divide the land adjacent to these drains into small units each of which can be provided with interior drains and a suitably located pumping plant. Sufficient experience has not been had with pumping plants in this region to permit of recommendations at this time in regard to capacity. The required capacity will depend to some extent on the crops it is intended to grow and the seasons in which they will be grown. The region is one of heavy rainfall and adequate capacity to maintain drainage is essential.

Limited experience with sugarcane and other crops has shown that during dry periods irrigation is of much value. Plants should be so arranged that pumping can be either out of or into the areas they serve. In soils of this character it is always desirable to hold the water table as high as possible, consistent with the best growth of the crops. Sugarcane uses large quantities of moisture and on lands that are to be utilized for growing cane it is essential that provision be made for irrigating. Until the Everglades are fully developed it is desirable that the water table be held as high as possible in the undeveloped area so as to reduce the hazard from fire which now causes serious damage to the lands. For this reason the outlet canals should be provided with gates or locks for controlling the water level, if the canals are to be used for navigation. Owing to the fact that parts of the Everglades are higher than the surrounding land, if the water level in the canals is not so controlled the water will drain out of the area and the peat will be seriously damaged by the fires which periodically sweep over it.

SOILS IN THE EVERGLADES

This section deals with groups of soils or classes of soil material rather than with definite soil types. In the limited time available for the investigations it was possible to gain only a general idea in regard to the soils of this vast area.

In 1915 a soil survey of a strip of territory across the Everglades, extending from the south shore of Lake Okeechobee to the Atlantic Ocean, was made. Borings were made at 1-mile intervals throughout the territory covered by this survey and the character and depth

of the material were recorded. (For a detailed description of these classes of material and the definite soil types, see Soil Survey Report of Fort Lauderdale area, Florida.) At that time a very small percentage of the land in the Everglades was sufficiently drained for cultivation and only a small area in the aggregate was devoted to crop production. Since that time, however—and more particularly in the last few years—more of this land has been drained, roads and railroads have been built, lateral canals have been dug and several small towns have developed. Previous to the establishment of the Everglades experiment station and until the Brown Co. and the Southern Sugar Co. began operations in the Everglades and around the shores of Lake Okeechobee, practically no real experimental work had been conducted on the muck and peat soils of this region.

The major soil groups of the Everglades district are described under the following headings: (1) Muck; (2) peaty muck; (3) peat; (4) shallow muck, peat, and peaty muck; (5) marl land; (6) sandy soils; and (7) shallow limestone soils and rock outcrop.

Muck.—The largest areas of muck occur within a narrow belt 1 to 2 miles or more in width on the southeast side and southern border of Lake Okeechobee. Other small spots and areas are scattered around the lake and along the edges of the Everglades. This area includes what is locally known as the "custard-apple region." Practically all of this muck has been cleared of its native vegetation which was chiefly custard apple and moonvine.

The muck consists of black, finely divided, and well decomposed vegetable matter containing from about 35 to about 60 per cent of very fine sand, silt, and clay. It is uniform in texture, structure, and color to an average depth of 35 or 40 inches, but in a few places it extends to a depth of from 60 to 70 inches below the surface. When wet it is slightly sticky and somewhat compact but upon drying it becomes quite hard and develops surface cracks. Underlying the muck is a brown to dark-brown fibrous peat or black peaty muck which extends to the limestone encountered at from 8 to 10 feet below the surface.

The greater part of this area of muck has at one time or another been used for the production of vegetables, such as Irish potatoes, eggplant, peppers, cabbage, tomatoes. beans, onions. Recently extensive areas have been planted to sugarcane. It has been considered to be the best land in the Everglades. The total area of this class of muck is estimated to be between 35,000 and 40,000 acres.

Peaty muck.—The peaty muck usually is a black or dark-brown peaty material to a depth of several inches, but in some places it consists of alternate layers of black peaty material and brown fibrous peat. The peaty muck does not contain as high a percentage of mineral matter as the muck, nor is the organic matter as thoroughly or uniformly decomposed. This peaty muck borders the muck or custard-apple area south of Lake Okeechobee but there are also many spots of it throughout the Everglades, especially along the Miami Canal and in the vicinity of the old site of the Pennsylvania sugar mill. Oven-dry samples of peaty muck show a loss on ignition of from 70 to about 85 per cent. Examination of this material usually shows at the surface a black, slick, sticky peat, 6 to 8 inches in thickness, becoming somewhat less pasty below and grading into more fibrous material at from 28 to 36 inches below the surface. In some

localities the layers of well-decomposed peat alternate with layers of fibrous material.

Considerable areas of the peaty muck have been planted to sugar cane within the last two years, and vegetable crops have been grown on portions of it for a number of years.

Peat.—Peat is the typical saw-grass material of the Everglades. Perhaps there are one and one-half to two million acres of this material comprising the greater part of the so-called Everglades. It is a remarkably uniform body of material, consisting of brown fibrous to dark-brown, semifibrous, slightly decomposed vegetable matter, dominantly of saw-grass (Cladium effusum) composition. It varies in depth from about 4 to about 9 feet and is normally underlain by limestone. In some places a shallow layer of white sand is interposed between the peat layer and the basal limestone. Where it has been burned over, there is a slight accumulation of brown or ocherous-colored ashy material at the surface. Extending for a distance of from 10 to 20 or more miles from the lake, a black, slick, slightly plastic peat or peaty muck, with some fibrous material running through it, usually is encountered somewhere between 24 and 40 inches below the surface. This layer is ordinarily from 4 to 8 inches in thickness. In some places the brown fibrous peat is underlain at about 30 or 40 inches by a black nonfibrous peat, which extends to the limestone. In the southern portion of the Everglades, along the Tamiami Trail, are extensive areas of black nonfibrous peat with streaks of brown fibrous peat. This is also true in places along the Miami Canal. The peat in its typical development loses on ignition from 85 to 96 per cent of its weight of oven-dried sample.

The Everglades Experiment Station and the lands of the Brown Co. are located on typical areas of peat. Until recently practically none of this peat was farmed, but within the past two or three years some areas have been drained and planted to a large variety of vegetable crops. The Southern Sugar Co. is preparing some of this peat for sugarcane growing.

Shallow muck, peat, and peaty muck.—This classification includes areas of muck, peat, and peaty muck varying in depth from a few inches to 3 feet or more. This material lies between the sandy soils and the typical peat areas. In places there is much to a depth of a few inches, underlain by brown fibrous peat. Again, there are some areas of peaty muck and black nonfibrous peat. These materials are underlain by limestone or by a thin covering of sand over limestone. In the vicinity of Davie the material is a muck or black peaty muck underlain by brown fibrous peat or black nonfibrous peat.

Considerable areas of this material have been cultivated for some 12 or 15 years. The main crops grown here are vegetables, oranges, and grapefruit.

Marl land.—In the southwestern part of the drainage district there is an extensive area of so-called marl land. This soil consists of a light gray or almost white, very silty material carrying a high percentage of lime. It is very uniform in color, texture, and structure throughout its depth. It ranges in depth from 6 to 30 inches, and it is underlain by coralline limestone. In places this limestone comes to the surface and in other places there are pot holes where the soil may extend down to 2 or 3 feet.

The principal growth on this marl land is cypress. Much of this cypress is extremely dwarfed and gnarly. Scattered throughout this area are prairie areas that support a vegetative growth of sawgrass or other coarse grasses. A large part of this land, owing to the nearness of the limestone rock to the surface, is unfit for any crops except very shallow rooted ones. However, some of the prairie areas, where the soil material is 12 to 30 inches deep, have produced excellent crops of tomatoes, peppers, beans, etc.

Sandy soils.—On both sides of the Everglades and also to the north of Lake Okeechobee are extensive areas of sandy soils. This classification includes several well recognized soil series. In the north part of the district there is a large acreage of the typical Florida flat woods. Bordering the coast on the east side of the Everglades, sandy ridges, marshes, and strips of flat, poorly drained sand occur. Beginning to the south of Fort Lauderdale and extending through Miami and for a short distance to the south of Florida City, the coralline limestone comes near the surface and there are outcrops of this rock over extensive areas in many places. In the vicinity of Redland there are areas of reddish-brown silt and clay-loam soil which occur in the pot holes of the limestone. On the west side of the Everglades—that is, to the south of Lake Hicpochee—is an extensive area of flat woods and swamp.

Some of these soils, especially in the vicinity of Dania, Miami, Gould, Homestead, and Florida City, have been used for the production of citrous fruits and vegetables.

General remarks.—Since 1915 drainage conditions in the Everglades have progressively improved. At Okeelanta, on the North New River Canal, the peat as mapped in 1915 varied in depth from 117 to 123 inches to the limestone rock below. In July, 1929, borings made at Okeelanta reached the limestone rock at 72 to 80 inches, thus indicating a subsidence and settling of the material 40 or more inches.

The need for controlled water conditions is demonstrated by the fact that the peat when once dry and set afire will burn down to the water table. Practical experience has shown that the water table should be maintained at about 24 to 36 inches below the surface in order to supply adequate moisture for growing crops.

Soil amendments have apparently revolutionized the productivity of the raw organic soils. It has been demonstrated at the Everglades Experiment Station, by the Brown Co. on the Hillsboro Canal, and by the Southern Sugar Co., that certain crops will not produce fruit except where these mineral amendments have been applied. Experiments at the Everglades Experiment Station indicate that the organic soils—the muck and better decomposed peat—may not need as much nitrogen and phosphorus as formerly was thought necessary, although still needing potash as do practically all peats and mucks of high organic-matter content.

LIVESTOCK POSSIBILITIES

Livestock and poultry have gained a foothold in the areas bordering the Everglades, especially in those localities within 30 miles of the population centers along the east coast, and in the adjacent territory lying to the northwest of the Everglades. In the areas east and southeast of Lake Okeechobee the livestock consists almost entirely of

dairy cattle and chickens. Native beef cattle are found in considerable numbers between Moore Haven and La Belle on the prairie land adjoining the Everglades. Because of the lack of water control cattle production within the Everglades has not developed to any important extent. Areas suitable for cattle at certain times of the year are useless at other times because of flood waters. During rainy seasons which come in rather definite cycles (August and September) there is essentially no dry land available on which to turn the stock.

The limiting factor, therefore, under present conditions is surplus water. The question then is, "What can be done with livestock if drainage and flood control can be effected?"

A number of species of grasses suitable for cattle can be produced on the muck lands, as, for instance, Carpet grass, Bermuda, Para, Dallis, and Napier grass. Other crops such as the sweet and grain sorghums produce large tonnage per acre, which can be used very satisfactorily either as soiling crops or as silage. Shallu—often called Egyptian wheat—has done exceptionally well in a few places where it has been given a fair trial.

In the more suitable grazing seasons it is reported that from one to four head of cattle can be grazed per acre on good, improved pasture and from 15 to 25 tons of silage crops (not including corn) can be produced on one acre. Corn can be produced but the yields will be considerably under such crops as the sorgos (sweet sorghums).

Under present conditions and for a considerable time to come the grasses and coarser forages will have to be marketed through livestock by grazing, by making silage, or by feeding them green as soiling crops. The humid climate is not favorable to the curing of hay.

The dairy industry, as mentioned heretofore, has been developed on a satisfactory basis on areas located relatively close to the larger cities. Reliable dairymen report that they can produce milk at from 12 to 48 cents per gallon. The cost varies greatly, depending of course on many factors—such as the investment in equipment, grade of milk produced, distance from market, and seasonal conditions. The established dairies are capable of supplying the nearby cities with milk during the summer months, but can supply only approximately forty per cent of the demand during the tourist season.

The poultry business is in practically the same status as the dairy industry as regards supply of and demand for products. Pork production as an industry is practically nonexistent. Some feeder pigs might be raised as a side line to the dairy industry should it develop to the point that skim milk is available for pig feeding. The unlikelihood of grain being produced in appreciable quantities practically excludes the production of hogs on a commercial basis.

The local beef supply, so far as the tourist or winter trade is concerned, is entirely inadequate in both quality and quantity. This trade demands finished beef which can not be produced in southern Florida because of the lack of suitable finishing feeds, and the great expense of bringing in such feeds from the grain-production areas. However, a considerable demand exists among local people for beef not so highly finished. This lower quality of beef can be produced on feeds which may be grown in the Everglades.

One should not go into the beef-cattle business without making preparation in advance. Pastures must be provided. It would be

desirable to farm the muck land a year or two before seeding it to pastures. The soil at first is likely to be too loose for cattle and they would have difficulty in getting over the land because of its spongy fibrous character. The soil becomes more plastic and solid as it is worked.

On account of lack of finishing feeds in the Everglades the production of feeder cattle on improved range after drainage would stand a better chance of being feasible than would the production of finished cattle. It is questionable, however, whether the annual income resulting from the use of improved land for pasturage would be sufficient to justify employing the land for this purpose. Moreover, no marked expansion of the beef industry is necessary at this time. The beef production areas as we have them to-day are able to supply this country with sufficient beef, and any appreciable expansion in this direction would tend toward unprofitable production. In fact, the low point in the present cycle of beef production has been reached as the result of liquidation brought on by the heavy production and low prices from 1921 to 1925. When we need a greater beef production there are many regions in which the industry will be expanded and with which the Everglades would have to compete.

Should drainage and flood control become general throughout the Everglades, dairying and poultry raising for local consumption, and production of feeder cattle, might be found a means of helping to stabilize agriculture in this district, particularly for small farmers.

VEGETABLE GROWING

Vegetable production in the Everglades proper is at present confined chiefly to a crescent-shaped area embracing the southern half of the shore line of Lake Okeechobee and varying from less than a mile to 3 or 4 miles in depth from the lake. Most of the vegetable production is on soils of the custard-apple type, although some plantings are found on the sandier phases at the border of the Everglades region. Comparatively little use has as yet been made of the sawgrass peat. Vegetable developments worthy of mention have been observed in the vicinities of Port Mayaca, Canal Point, Pahokee, Belle Glade, Chosen, and continuing along South Bay to Clewiston and Moore Haven. Lesser developments are reported along the west shore and also along the north shore in the neighborhood of Okeechobee.

The total volume of vegetable shipments from the Everglades region is, of course, small in comparison with the total shipments from the State of Florida as a whole. Some idea of the magnitude of the industry in this region may be gained from Table 3.

119038—R. and H. Doc. 47, 71-2——2

TABLE 3.—*Vegetable shipments from the Everglades* [1]

	1924	1925	1927	1928
Canal Point, Belle Glade, Chosen:	*Carloads*	*Carloads*	*Carloads*	*Carloads*
Beans			963	677
Cabbage			2	8
Eggplant			5	10
Onions				3
Peas			1	1
Peppers			23	63
Potatoes			8	239
Tomatoes			249	531
Mixed vegetables			30	213
Total			1,281	1,745
Clewiston, Moore Haven:				
Beans	199	370	292	36
Cabbage	107	5	1	25
Eggplant			6	4
Onions				8
Peas				2
Peppers			10	1
Potatoes	92	10	19	16
Tomatoes	337	266	164	118
Mixed vegetables			65	55
Total	735	651	551	265
Okeechobee:				
Beans			17	4
Cabbage				
Eggplant			1	
Potatoes	13	3		15
Tomatoes	114	190	28	54
Mixed vegetables	2	24	6	2
Total	129	217	52	75
Grand total	864	868	1,884	2,085

[1] Totals are probably somewhat higher than shown since conductors' waybill shipments are not included in these figures. These were omitted since point of origin was unidentified with chance that shipments may have originated other than in the Everglades proper.

As to whether or not the lands in question have the capacity for producing reasonable yields of various crops the carload shipments from comparatively small areas of intensive culture afford the best evidence. Recent work done by the Florida Agricultural Experiment Station and by private concerns working upon the saw-grass soils have shown that these soils will produce good yields of a wide range of vegetable crops. It is not to be intimated that soil problems are all solved, nor that soil improvement and fertility are not among the limiting factors, but the general feeling at present seems to be that these things are limiting factors less often than are wind, water, and frost.

The principal crops at present being grown in the region in question are beans, tomatoes, eggplant, and peppers, with considerable shipments of mixed vegetables and some potatoes, cabbage, and peas. The bulk of the shipments may be classed as winter and early spring vegetables which do not compete very heavily with products from other States, except Texas. Of course, there is competition within the State. There is fear that if extensive developments are opened up within the Everglades such an overproduction will be faced that not only competing regions may suffer but the new developments themselves may fail to reap a profit. Prices of these commodities during November, December, January, February, and March, in most seasons (as shown by compilations of the Florida State Marketing

Bureau) remain at sufficiently high levels to yield a reasonable return if growers are fortunate enough to harvest fair crops. At the same time the hazards of wind, water, and frost in the Everglades render returns very uncertain and most growers look upon vegetable production at the present time as very much of a gamble.

In view of winter prices, it would seem that markets might absorb considerably more Florida vegetables during the mid-winter and late winter months. This probably would mean that prices would come down to somewhat below their present levels, but if production were kept within reasonable bounds there should be a place for more material than is now marketed. It is not possible to say, however, just when this increased production would operate to bring prices down to a point of no profit to the growers. With the huge areas evidently capable of being improved, it appears that expansion must be made with great caution, lest the vegetable industry be faced with overproduction and suffer serious damage.

Because of the great hazards of weather, as well as of the economic hazards, vegetable production in the Everglades seems to be a business primarily for the large operator with sufficient backing to tide him over the frequent losses which under present conditions are certain to occur. In the present state of development the region does not appear to be particularly inviting to the small grower, even though it must be admitted that some individuals have, with rare good fortune, started with very small means and developed large and profitable plantings.

Improvements which are being made by private enterprise in transportation facilities bid fair to reduce transport costs to New York and Philadelphia. Precooling plants, refrigerated boats, and improved harbor facilities on the east coast should be of material aid to the growers. In the last three years boat shipments of vegetables have increased many fold on a certain line and the rapidly increasing number of commodities shipped is notable. Not all of these commodities, nor all of the shipments, originated in the Everglades area, but with improved facilities for trucking and barging from the Everglades to the coast the facilities now under improvement are of considerable interest.

SUGARCANE CULTURE

History of sugar enterprises.—For many years attention has been given to the possibility of growing sugar cane in the peat soils of the Everglades, both for sirup and for sugar production. The sugarcane plant was introduced early in the history of the State and has been continuously grown in the settled portions of central and northern Florida for more than 150 years. It is claimed that the first instance of sugar fabrication within the present boundaries of the United States was that of the indentured colonists of New Smyrna who occupied land on the east coast from 1767 to 1776. Cane was more or less extensively planted and sugar made from it from that time on, the sugar production of Florida reaching 3,300,000 pounds in 1850, according to the United States census report for that year. After the Civil War a decline in sugar production took place, but some was manufactured up to the close of the last century. The total acreage in sugar cane has gradually increased, however, the crop in recent years being used almost wholly for sirup production.

Sugar cane, therefore, has long been familiar to the agriculturists of Florida, and it is not surprising that the scattered early settlers of the Everglades—from Lake Okeechobee to Cape Sable—carried seed cane with them and planted it. In the vicinity of Lake Okeechobee hundreds of small patches of cane were planted for sirup during the years from the beginning of the present century until the succession of storms and floods of the past 10 years completely discouraged planting on these undrained lands.

When during the development of the crop the water table has remained well below the ground surface, the luxurious growth of the plants has compelled the attention of experienced sugarcane planters and has been responsible for unusual interest in this area as potential sugar-producing country. Especially during the past 10 years have projects been started with comprehensive programs for the planting of cane and the erection of modern mills in the Everglades. Noteworthy among these was the venture of the Pennsylvania Sugar Refining Co. of Philadelphia, which undertook to grow cane extensively on peat lands acquired along the Miami Branch Canal in Dade and Broward Counties. Actual planting commenced in the winter of 1919–20 with seed cane obtained from Ritta Island in Lake Okeechobee. The next year, work was started at a point 18 miles northwest of Miami on a mill which was completed in 1922 at a cost of about $1,500,000. This venture was undertaken without adequate knowledge of the Everglades soils and with insufficient protection against floods. It is significant that while the small fields of cane on Ritta Island, from which the seed cane was obtained, yielded nearly 60 tons of cane to the acre, the company produced on some thousands of acres of its own land not more than 5 to 12 tons per acre. The explanation of this poor showing is to be found in failure to select soils of known performance in cane production and failure to provide drainage. After several disastrous years of flood—during which millions of dollars were lost—the mill was sold and moved away in 1927 after the sugar-growing project has been definitely abandoned.

About the time the Pennsylvania Co.'s project was started another development—destined for a series of disheartening experiences but fundamentally more sound in conception and brighter in prospects—was started by the Florida Sugar & Food Products Co., at Canal Point. The lands acquired by this company were situated along the southeastern shore of Lake Okeechobee where a considerable proportion of them was of the superior type of known performance. A system of low dykes was erected and a pumping plant was installed for protection against high water. About 1,000 acres of sugarcane was planted with seed cane obtained locally from the small patches grown for sirup, and a mill was erected in 1922 on the West Palm Beach Canal, about 2 miles from Lake Okeechobee. Unusually high yields of cane of acceptable quality were obtained the first year or two from fields situated in the custard-apple belt. Forty to fifty tons of cane per acre were not uncommon yields on these soils. Experimental plantings on the saw-grass lands were much lower in tonnage than those on the better types of soil. However, the average yields of all fields compared well with those of the most favored sugarcane areas of the world. The percentage of sugar in the juice was good and the purity was reasonably high.

Making due allowance for the vicissitudes of the weather—particularly the tropical storms and the short periods of cold weather that periodically visit this region—it seemed to the promoters of the enterprise that profitable production of sugar was assured. However, it appears that one of the obvious hazards peculiar to the Everglades—the ever-present danger of floods of unusual proportion—was not adequately provided against, and unfortunately there followed a succession of floods disastrous to the cane crops. Despite the precautions that had been taken, the lands were inundated completely or in part on several different occasions, and the water remained in the cane fields for periods of from five to eight weeks. The cane was greatly injured and much of it made useless for grinding. The mill was operated in 1923 and 1924, producing about 1,000,000 pounds of sugar during each of the two campaigns. This small output fell so short of expectations that the company found itself in financial difficulties from which it might have been difficult to extricate itself but for the assistance of another group which at this time became interested in sugar production in the Everglades. This was the Southern Sugar Co., which had started operations at Clewiston in 1925. The new company had considerable resources, but at that time its land holdings did not include any extensive portion of the areas known to be suitable for cane culture. The Florida Sugar Co., on the other hand, was fortunate in controlling a large acreage of custard-apple land consolidated in blocks suitable for plantation operations. By this time the company realized, however, that more adequate control of water was imperative, and the heavy expense of this improvement following its reverses offered a serious problem. The situation was met by merging of the two companies, the stockholders of the older company receiving stock in the new company on advantageous terms.

The Southern Sugar Co. was well advised in the selection of other lands which it now began to acquire and also, for the first time in the history of the Everglades, it proceeded on the principle of planting only in drained land provided with dykes and pumps. Danger of drowning of the crops is now far less than in the case of earlier enterprises and excepting for the menace of winds of hurricane force—which have twice within recent years driven the lake waters over the land with appalling loss of life and property—the problem of water control seems well advanced toward practical solution.

A mill capable of grinding 1,500 tons per day was completed at Clewiston in January, 1929, and was increased in size during the year, so that it now has a capacity of 4,000 tons. This mill will begin its campaign January 2, 1930, and it is estimated that nearly 100,000 tons of cane will be available for grinding.

Planting operations continued throughout the summer and early winter of 1929, and up to the present time about 16,000 acres have been planted which, if brought to maturity, will assure a full campaign for the mill next year.

It has been mentioned that the original large holdings of the Southern Sugar Co. did not include any considerable proportion of the custard-apple land. Thousands of acres of this type have been purchased, extending from Liberty Point on the southwest shore of Lake Okeechobee to Canal Point on the east shore, but great areas of sawgrass peat lands of more doubtful value for sugarcane culture have

also been planted. Following the interesting experiments made by Dr. R. V. Allison, of the Florida Everglades Experiment Station, the results of which are mentioned later, this land was fertilized and treated with copper sulphate before planting, and the expectation of the company is that it will prove profitable even though yields are considerably less than those of the naturally productive custard-apple land.

Present status.—In 1920 the sugarcane breeding activities of the Department of Agriculture were moved to Canal Point from Collins Key, opposite Miami, where work had been started the previous year. The location at Canal Point was selected after nearly a year of investigations as offering the most suitable conditions to be found within continental United States for cane breeding. In this region many varieties of the sugarcane plant reach full maturity and produce viable seeds regularly. No other area is known where conditions of climate and soil bring about full maturity practically every year. In the course of nine years' activity at Canal Point in the production of selfed and hybrid seedling canes considerable information on the response of sugarcane to local conditions has been gained from experiences, although no formal experiments on field practices in the culture of cane in the Everglades have been carried on. Until the present year, when agronomic experiments were initiated at Canal Point, efforts have been restricted primarily to breeding work for the benefit of the established American sugarcane industries, and only incidentally for the new local industry.

Opinion as to the practicability of sugarcane culture in the Everglades has no bases of ample, carefully controlled experimentation. It must rest mainly on observation of commercial culture covering a period of 10 years, interpretation of physiological experiments having a bearing on the quality of juices but not on yields of sugar per acre, and interpretation of the results of soil treatment carried on by the Everglades experiment station of the University of Florida. Unfortunately the latter experiments were for the most part abortive, due to the disastrous hurricanes and floods of 1926 and 1928, and to the high water of 1929 which terminated prematurely these very interesting and suggestive researches.

Soils.—On the better type of land near the rim of the lake when the water table is well below the surface, the dark green of the foliage and exuberance of growth of the natural vegetation pushing out of the black earth in such lavish abundance as to be almost perceptibly growing, is startling when first observed and invariably impresses the newcomer most forcibly. The cultivated crops—such as beans, tomatoes, and peppers—respond to the fertility of the soil in the same way in favorable seasons. Sugarcane is no exception to the rule. It makes a most impressive growth on virgin land during the first few years of cultivation without the addition of fertilizers.

In sharp contrast to the unusually good growth on this custard-apple land, the development of sugarcane plants on the drained but untreated saw-grass land is greatly restricted. Frequently the crop makes a fair growth at first but a few months after planting the rate of growth is retarded and eventually comes practically to a standstill. The stalks are spindling, the plants are stunted, and in general present an unthrifty appearance. The aspect of the plants suggests poisoning and in fact it is not unlikely that some toxic principle re-

sides for some time in the recently drained saw-grass soils. In addition, they are apparently deficient in the nutriments essential for normal development of the gross-feeding cane.

Between these two extremes are found, in the intermediate soils, all types of development of the plant, suggesting that there is no possibility of a natural classification based on the chemical, physical, or biological soil characteristics. It seems rather that there is a gradual transition as one proceeds landward from the favorable conditions for growth in the custard-apple soils located in general on the lake shore, to the unfavorable conditions of the saw-grass soils. The statement that the former are merely saw-grass lands that by reason of higher elevation and consequent better aeration have improved as a substratum favorable for the growth of cultivated-land plants, is frequently heard. There can be no question that aeration is essential, but it must be recognized that the Everglades peat soils are not homogeneous.

It has been abundantly demonstrated by numerous trials that the saw-grass soils, comprising the bulk of the Everglades, are of no value for commercial cane culture, in their primitive conditions, even when the water table is at a favorable level. The experiments of Dr. R. V. Allison and Dr. H. P. Vannah, who adapted to this region the work of several investigators of peat soils elsewhere, have however significantly changed the outlook for profitable utilization of the saw-grass lands for cane growing. It has been demonstrated that by the application of small amounts of copper sulphate to these soils the growth of sugarcane is greatly improved. This salt—and also manganese sulphate—alone and in various combinations with potash and superphosphate has been tried not only in the small plots of sugarcane at the experiment station at Belle Glade, but also on a field scale at Canal Point. Here a field of over 100 acres of typical saw-grass land belonging to the Southern Sugar Co. was divided into 1-acre plots and planted to several different varieties of cane after the application of the treatments, in March, 1928, shown in Table 4.

TABLE 4.—*Outline of soil treatments used for sugarcane experiments upon raw saw-grass soil at Canal Point in cooperation with the Southern Sugar Co.*[1]

SERIES NO. AND TREATMENT[2]	
1. Check (no treatment).	15. Cu–2K.
2. Copper sulfate (cu).	16. Cu–2P–2K.
3. Manganese sulfate (Mn).	17. 3Cu.
4. Cu–Mn.	18. 3Cu–K.
5. Cu–Superphosphate (P).	19. 3Cu–2K.
6. Cu–Potash (K).	20. 3Cu–2P–2K.
7. Cu–P–K.	21. 3Cu–3Mn–2P–2K.
8. P–K.	22. 3Cu–3Mn–2N–2P–2K.
9. Mn–P–K.	23. Cu–P–K.[3]
10. Cu–Mn–P.	24. Cu–2P–2K, cultivation.[3]
11. Check.	25. Cu–K.
12. Cu–Mn–K.	26. Cu–P–K.
13. Cu–Mn–K–P.	27. Cu–Mn–P–K.
14. Cu–Mn–Nitrogen (N)–P–K.	28. Cu–Mn–N–P–K.

[1] From unpublished experiments by the Florida Everglades Experiment Station.

[2] X-quantity of copper and manganese sulphate at rate of 50 pounds per acre. All other materials applied at rate of 800 pounds of a 6–12–12 mixture with nitrogen derived equally from the three sources, dried blood, sodium nitrate, and ammonium sulfate. In re-treatment following the storm the phosphoric acid application was reduced to one-half and treatment made upon the basis of a 6–6–12 mixture at the same rate per acre.

[3] Muriate of potash instead of sulfate as in all other cases.

The response of the plants up to the time of the hurricane of September 16–17 was about the same as indicated in earlier small-scale tests, namely, the checks were stunted and actually dying in some instances; the plots with copper had produced a good stand and relatively good development of cane; copper and potash gave the best growth; adverse response was noted where superphosphate was applied, but this effect was mitigated to some extent when in certain combinations with manganese.

It is regrettable that this experiment was interrupted by the hurricane so that no actual yields were recorded. Up to the present no comparative yields of treated and untreated field-scale plots are available. The tendency to augmented growth with copper-sulphate applications has been so marked, however, that all plantings on the saw-grass lands by the sugar company are now, as routine practice, treated with this salt at the rate of 50 pounds per acre.

The incompleteness of these experiments leaves open the question of whether utilization of these lands is justifiable from a cost-of-production standpoint while the superior but more costly custard-apple lands are still available. Commercial interests have accepted the evidence thus far presented as sufficient to warrant planting these lands, apparently believing that the augmented yields from treated soils will more than repay all costs. After the wholesale planting of saw-grass land was started some additional field evidence that strengthens their position became available. Fields that will be ready to harvest when the campaign starts promise to yield several times the amount obtained by the Pennsylvania Co. on similar lands. If these estimated yields are realized, it must be admitted that the outturn is at least as good as average yields obtained in such established cane countries as Cuba or Louisiana.

Conditions prior to the installation last year of adequate dykes and pumps were such that the fragmentary records of field yields are not legitimate as indicating the possibility of cane production under conditions of improved water control. Some of the yield data from commercial fields near Canal Point are presented for what they are worth. All of the following yields were obtained on custard-apple land situated from 1 to 1½ miles from Lake Okeechobee:

Forty acres of variety S. C. 12/4 in section 26 used for seed cane in 1928 planted at the rate of 30 to 1. As an average of 1½ tons per acre of plant cane are used, the yield on this 40 acres was 45 tons per acre.

Thirty acres of Crystalina in section 34 yielded 40 tons per acre in 1924.

Forty acres of D–74 in section 34 yielded 51 tons per acre in 1923.

Seven acres of 36M in section 34 yielded 42 tons per acre in 1928.

Eighty acres of 36 P. O. J. in section 10 used for plant cane planted at the rate of 35 to 1 in 1929. The yield of this 80 acres was approximately 52½ tons per acre.

One acre of 2725 P. O. J. in section 4 used for plant cane in 1929 planted on 37 acres. The yield was 55½ tons per acre or more as the planting rate of this heavy-barrelled cane was in excess of 1½ tons per acre.

These fragmentary records are all that are available from commercial sources. They are believed to be conservative and to indicate quite accurately the yields of sugar cane to be expected on the superior types of custard-apple soil when well drained.

Weather and crop season.—The climate of the Everglades is more favorable for sugarcane culture than that of Louisiana but less favorable than some of the tropical sugar countries such as Hawaii and Java. There is a well-defined summer and winter and also a marked seasonal distribution of rain. The total precipitation is sufficient for the normal development of sugarcane and the heavy rains occur in midsummer and autumn when most needed for advancing the growth of the crop. In the winter there is generally little rainfall, and this, with the accompanying low temperatures, results in conditions promoting the desired ripening of sugarcane. Experience has shown that cane may be planted to the best advantage in the fall and harvested the second winter following. Spring-planted cane should be harvested at not less than 10½ to 12 months of age, and therefore, to fit into a rational system of harvesting, a large proportion of spring-planted cane is undesirable. To take advantage of the conditions favoring ripening—which begin as a rule in late October or November—the grinding campaign may in favorable seasons start shortly after that time and extend until March. It is apparent that earliness in at least some varieties of cane is desirable to permit extension of the grinding season, and one of the present objectives of the cane-breeding station is the production of early-maturing varieties. As in Louisiana, under normal conditions stubble crops may be harvested earlier than plant crops.

Reference to available temperature records (Table 1) shows that frosts injurious to the cane occur frequently. Fortunately the frosts are ordinarily quite local or "spotted" and there is an interspersion of small areas over the region where the cold is less intense and the cane remains uninjured. It is apparent that the affected cane may be ground before inversion of sugar has progressed very far and the remainder allowed to stand in the fields until needed. General freezes are not unknown and without much question serious losses would result from them. Ordinary prudence demands that they be taken into account and provisions made to minimize these risks and to cover such losses as will occur. The sugar company has planted a considerable amount of the cold-tolerating varieties like the Chunnce-Cheribon hybrids which are not killed outright even when exposed for short periods to temperatures several degrees below freezing. An improved weather-forecasting service would further minimize the danger of serious losses from freezes although it is not known just what protection would be afforded by such an expedient as windrowing the cane when a forecast of a freeze is made. In Louisiana where freezes occur regularly and much earlier than in Florida the situation is met more or less successfully by this method. While the freeze hazard should not be overemphasized, it must be admitted that weather records are incomplete and there is considerable uncertainty regarding what may be expected in certain areas, particularly those located several miles inland from Lake Okeechobee.

The land adjacent to the shore enjoys the moderating influence of this great body of water. The belief of long-time residents of the region, based on observation of the relative damage done to winter vegetables by frosts, is that the saw-grass areas more remote from the lake are "cold" lands. Authentic records of sirup-cane patches that have retooned for 10 years or more with no material decline in yields, show clearly that on the custard-apple land, at least, no damage to roots or stubbles from cold may reasonably be expected.

Analyses of juices.—The question of whether juice from cane grown on the peat soils of the Everglades is suitable for sugar fabrication is often raised. A large amount of data on this subject are available from records of the sugarcane breeding station and from other sources. It is conclusive, and indicates that no difficulty may be expected in working up the juices in the mills. The percentages of sucrose and the purities are comparatively high and the percentages of invert sugar are remarkably low. The following figures (Table 5) taken from the records of a time-of-maturity experiment conducted at the Bureau of Plant Industry Field Station at Canal Point are the results of analyses of various varieties made in March, 1928:

TABLE 5.—*Analyses of cane juices*

Variety		Brix	Per cent sucrose	Per cent purity	Per cent invert sugar
		17½° C.	*Dir. pol.*		
P. O. J. 36 [1]	T	15.70	13.00	82.8	0.35
Do.[2]	B	16.25	13.85	85.2	.44
P. O. J. 213	T	17.00	14.30	84.1	.20
Do	B	17.85	15.60	87.4	.20
P. O. J. 234	T	17.25	14.50	84.1	.34
Do	B	18.20	16.20	89.0	.10
P. O. J. 2364	T	18.75	15.85	84.5	.56
Do	B	20.00	17.45	87.3	.30
P. O. J. 2714	T	19.55	17.10	87.5	.39
Do	B	20.05	18.15	90.5	.30
P. O. J. 2725	T	19.45	17.25	88.7	.10
Do	B	19.50	17.45	89.5	.10
P. O. J. 2727	T	18.05	14.80	82.0	.72
Do	B	18.70	15.45	82.8	.74
Crystalina	T	16.90	14.30	84.6	.54
Do	B	17.90	15.70	87.7	.29
Yellow Caledonian	T	16.80	13.15	78.3	.91
Do	B	17.85	14.30	80.1	.55
Louisiana Purple	T	17.30	15.05	87.0	.49
Do	B	17.85	15.90	89.1	.35
D–74	T	16.45	13.75	83.6	.44
Do	B	16.55	14.15	85.5	.54
CO–281	T	17.60	14.45	82.1	.10
Do	B	18.00	15.05	83.6	.10

[1] Top half of stalk. [2] Bottom half of stalk.

These figures indicate that with similar cane well over 200 pounds of sugar per ton of cane may be recovered by mills of ordinary efficiency. The only figures on actual recoveries by mills were furnished by the Florida Sugar & Food Products Co., which reports a yield of 213 pounds of sugar per ton of D–74 cane during its campaign of 1923. Even better yields of sugar may be expected, other conditions being equal, with the more efficient modern mill.

Disease and insect pests.—Up to the present the region under discussion has enjoyed a distinct advantage over most commercial cane countries in its relative freedom from dangerous diseases and insect pests. The only disease of importance reported from the Everglades area is mosaic. Mosaic has been responsible for very serious losses in Louisiana in the past, but control measures applicable to Florida have recently been put in practice and losses greatly reduced. The substitution of mosaic-tolerating varieties for the old susceptible varieties is the principal control measure. Not only has the sugar company planted a considerable proportion of its fields to tolerant varieties, but at present all seed cane used for new plantings is cut from fields certified to be free from mosaic. These practices will

retard the spread of the disease and limit the losses to some extent, but production nevertheless will be curtailed to a degree.

Of the insect pests reported in the Everglades the sugarcane moth stalk borer is the only one of consequence. Several years ago parasites of this insect were imported from Cuba and liberated near Canal Point. Whether the parasites have played an important part in reducing the borer population is not definitely known but borer injury has been less conspicuous in the cane fields in recent years than formerly. The borer causes great injury to cane in Louisiana at times and it creates a problem worthy of serious consideration in Florida.

Miscellaneous considerations.—The present large-scale cane-growing enterprise in the Everglades is unique in several respects apart from the unusual soil, climatic, and other conditions mentioned. The Southern Sugar Co. has a market for bagasse to be used for the manufacture of insulating lumber, and profits from by-products are expected to be greater in proportion than is the case with other sugar-cane industries. It is estimated that bagasse up to a total of that represented by 8 per cent fiber in the cane ground will provide sufficient fuel to operate the mill. This means that the excess above 8 per cent fiber or, roughly, one-third of the total bagasse produced, will be available for use in the manufacture of synthetic lumber.

Unusual attention has been given to the development of labor-saving machinery, including cane planters and harvesters. The research division of the farm implement shops of the company has produced a planter that is being used successfully, and is now engaged in an attempt to perfect a cane harvester. The perfectly-level Everglades lands, completely free from stones, stumps, and other impediments would seem to offer an exceptionally good opportunity for mechanical harvesting if the problems involved in gathering, cutting, and topping can be solved.

HOW MUCH WILL THE EVERGLADES BENEFIT BY NAVIGATION AND CONTROL OF THE WATERS OF LAKE OKEECHOBEE?

Obviously no definite prediction in terms of dollars and cents added to the aggregate or per-acre income or land value of the region is possible. The preceding discussion has indicated that although the development of the copper-sulphate treatment for raw saw-grass soils has greatly improved the outlook for the utilization of this predominant soil type, the method is so recent that many uncertainties remain as to the residual effects of the treatment, the effect of continual cropping, and the kind and quantities of fertilizer that will be required. The frost risks in different parts of the area vary considerably as regards, particularly, the adaptability of temperatures to the production of sugarcane and winter vegetables. Considerable variation in soil character and particularly nearness of rock to surface in the southwestern part of the area introduce uncertainty as to just what proportion of the total area of the Everglades can be employed for farming, and especially as to the types of farming that will prevail in the different parts of the area. Finally, the economic experience of agriculture in the area and particularly in the saw-grass peat is extremely limited and there is available no series of statistics with respect to yields and costs that covers a period sufficiently long

to permit of definite conclusions as to the probable net rental value of the lands of the region.

Although it is impracticable to arrive at precise estimates of prospective land values and agricultural income with respect to this area, a number of facts are significant in throwing light on the probable advantages to be gained by providing the area with protection against floods from Lake Okeechobee, and with improved water-transportation facilities.

From the standpoint of protection against overflow the present degree of agricultural development, population, and property values would appear to have considerable significance. During little more than a decade the Everglades region has manifested a considerable advance in these regards. Population in 1915 is said to have been only 6,816 and to have been confined mainly to the eastern edge of the Everglades, near the Atlantic coast. The estimated population of the district in 1928 was 48,000.[1] In the same period the estimated number of acres under cultivation increased from 20,000 to 96,000, and assessed value of property for State and county purposes from $9,690,800 to $31,955,200.[2]

Because available statistics are either for the district as a whole or by counties, it is impracticable to determine just how much of this development is in the Everglades proper and particularly how much is in areas jeopardized by hurricane tides from Lake Okeechobee. However, a large proportion of the population, property values, and economic activity are in the area of custard-apple soil along the rim of the lake.

The custard-apple area.—There is but little question that the custard-apple soil is adapted to certain agricultural uses. This area, amounting to 35,000 or 40,000 acres, has been farmed for a sufficient number of years to demonstrate its serviceability as a soil for truck crops and its probable adaptability to sugarcane. The entire area of this soil is not yet fully used, mainly because of the hazards arising from possible floods and the demoralization that has resulted from the floods of the past several years.

If protected against hurricane tides, this part of the Everglades would be more fully utilized, human life and property values rendered more secure, and the latter probably increased considerably. Greater security would result in a better class of improvements and in more salutary conditions of living, for a considerable number of small farmers and hired laborers now live under conditions of make shift accommodations which must be characterized as little short of deplorable.

The present investments and productivity in this custard-apple territory are by no means inconsiderable. The lands and plant of the Southern Sugar Co. involve a capital investment of many millions. At Port Mayaca certain interests have developed a large truck-farm involving more than 800 acres of cultivated land, though mainly in the sandy soils rather than in the muck. A number of smaller truck farmers have substantial investments, not to speak of the considerable sums represented by the several towns and villages and by roads and railways.

[1] Biennial Report Everglades Drainage District, 1927–28, pp. 70, 76.
[2] Ibid.

This territory has peculiar advantages in the fertility of its soil, in its nearly level topography that permits use of labor-saving machinery, and in its winter temperatures which are somewhat higher than those which prevail in other parts of the Everglades. Its importance as a source of truck crops is shown by the fact—already noted in Table 3—that shipments of such products in 1928 from points near the southeastern border of Lake Okeechobee amounted to more than 2,000 carloads. When not damaged by frost, good yields of truck crops in this area are obtained even under comparatively poor drainage and inadequate fertilization. Table 6 shows yields in 1929 for individual growers as supplied by the Everglades experiment station; these figures serve to illustrate the productivity of the custard-apple and elderberry soils:

TABLE 6.—*Typical vegetable yields on Everglades soils in 1929*

Crop	Soil		Yield per acre	Price received	Fertilization	Drainage	Rental value of land per acre	Capital value of land per acre
	Type [1]	Area						
		Acres	*Bushels*	*Dollars*			*Dollars*	*Dollars*
Tomatoes	CA	5	100	1.00	None	Poor	10	150
Beans	CA	30	30	1.00	do	do	15	175
Do	CA	10	100	1.50	do	do	15	200
Do	CA	10	100	2.00	300 pounds	do	15	200
Do	CA	5	150	3.00	500 pounds	do	15	200
Do	CA	2	25	3.00	None	do	15	200
Do	E	10	150	2.50	500 pounds	Fair	15	200
Do	CA	10	100	2.00	None	Poor	20	150
Do	E	10	150	2.50	do	Good	15	100
Tomatoes	E	5	100	4.00	do	Fair	15	100
Potatoes	E	5	275	3.00	do	Good	35	300
Beans	E	10	100	1.50	do	do	25	175
Garden peas	E	5	250	3.00	do	do	25	175
Potatoes	E	10	225	1.25	do	do	25	300
Beans	E	5	250	1.25	do	do	25	300
Potatoes	E	30	300	1.75	do	Poor	20	300
Beans	CA	10	125	1.25	do	do	15	200
Do	E	10	100	2.00	do	do	10	150
Do	CA	5	100	3.50	do	Fair	10	150
Do	CA	10	130	2.75	500 pounds	do	20	200

[1] CA = Custard-apple soil; E = Elderberry soil.

The above figures evidently are not exact, being reported in only round figures. Moreover, most of them represent the experiences in a single year of small growers renting tracts of land generally poorly drained and farmed in most cases without fertilizer. The weighted average of gross receipts per acre is approximately $275, the average receipts for beans alone being about $206. The average gross return per acre for potatoes is $504; for tomatoes, $250; and for peas $750; but in the cases of the last three vegetables the number of reports are insufficient to constitute a significant average.

That these cases probably are well within the scope of the productiveness of the area under reasonably favorable conditions is shown by the following average values per acre for Palm Beach County in 1924, according to the Florida State Marketing Bureau: Potatoes, $400; tomatoes, $287; snap beans, $244; lima beans, $416; peppers, $697; English peas, $250; eggplant, $300; and celery, $800. These returns per acre may be compared with a 6-year average return per acre in the Plant City area of Hillsboro County, Fla., from 1917 to 1922, inclusive, which were as follows: Irish potatoes, $130; string beans,

$129; cabbage, $176; tomatoes, $151; eggplant, $192; and peppers, $203. While these figures represent 6-year averages, in only one year of the period were the returns per acre for beans and tomatoes as high as the figures shown for the Lake Okeechobee region, and the return for potatoes was not as high in any year as that for the lake region. These data, though inconclusive, suggest that the lake region—particularly when under efficient methods of cultivation—may be expected to produce a relatively high gross yield per acre in certain truck crops.

The relation between costs and returns of various truck crops located in custard-apple or "weed" soils under somewhat better average conditions with respect to fertilization and drainage, is presented in Table 7, which shows data for individual farmers in a single year, gathered by the director of the Everglades Experiment Station.

TABLE 7.—*Production costs per acre of various crops grown in the Everglades, 1928–29*

[Data obtained at random from a small number of producers reporting to the Everglades Experiment Station]

	Production costs per acre											
	Potatoes	Potatoes	Corn	Corn	Tomatoes	Tomatoes	Beans	Cabbage	Onions	Onions	Sugarcane	Peanuts
Plowing and harvesting	$8.75	$6.00		$6.00	$4.00	$2.00	$4.50	$4.50	$4.50	$6.50	$8.60	$6.00
Preparation of seed bed	3.50				1.00				3.50	3.00		
Fertilizer and distribution	10.30											
Cost of seed	22.25	35.00			1.00	2.00	10.00	12.00	8.00	12.00		5.60
Planting	5.25	5.00		2.50	2.00	1.00	1.25	1.25	1.50	2.00		2.00
Cultivation	7.25		$4.00	2.00	2.00	2.50	3.00	4.00	11.00	15.00	12.50	10.00
Hoeing	12.50											
Dusting	14.75											
Harvesting	24.50		5.00		9.00	60.00	70.00	25.00	15.00	25.00		6.00
Grading and packing	15.00				6.00	195.00		15.00	15.00			
Containers	40.95						32.00	95.00	12.50	55.00		
Hauling and loading	3.50											
Rent on land	10.00	3.33	6.66	3.33	11.50	10.00	10.00	10.00	11.00	10.50		6.66
Preparation of land and planting including seed			8.00									
Cultivation and spraying		10.00										
Harvesting and crates		40.00										
Harvesting and marketing				14.00								
Hoeing and thinning					.50	1.00		5.00				
Hauling					5.00	25.00	10.00	15.00	5.00	15.00		
Other costs, supervision					5.00				2.50	15.00		
Cost of fertilizer and application							10.00					
Weeding and thinning									10.00	15.00		
Spraying and dusting									.50	1.00		
Planting, including fertilization											34.25	
General expense											2.25	
Pulling												6.00
Stacking												6.00
Stack poles												2.00
Sacking												2.00
Total expense	178.50	99.33	23.66	27.83	47.00	298.50	150.75	186.75	100.00	175.50	57.60	53.86
Total yield	[1] 292	[1] 125	[1] 50	[1] 50	[2] 100	[2] 300	[3] 200	[3] 420	[1] 50	[2] 300		[4] 2,000
Receipts from crops			32.50	32.50								90.00
Net return			8.84	4.67								36.14
Net return exclusive of rent			15.50	8.00								42.80

[1] Bushels, [2] Crates, [3] Hampers, [4] Pounds,

Table 7 illustrates the fact that net returns from the growth of truck crops in this area are not nearly so high as one might be led to expect in the light of the gross returns per acre. A crop of potatoes yielding 125 bushels per acre without the use of fertilizers cost $96 per acre, not including land rent. The actual sale price is not stated in this instance. In three other cases, however, potatoes sold in the winter brought $1.25, $1.75 and $3 per bushel, respectively. Applied to the yields and costs just mentioned, these prices would have brought a net return ranging from $60.25 to $279. The yield from one crop of onions raised in a year was very poor owing to a dry spring, but it was of excellent quality and brought a net return of $61 per acre, exclusive of the item for rent on land which also included taxes and interest. Another crop of onions netted $499.50 per acre. A crop of tomatoes, raised under somewhat unfavorable conditions by reason of the flood which made it possible to pick only twice instead of three or four times, yielded a net return of $42.50. A crop of beans was estimated to cost $140.75 exclusive of land rental. The yield was 200 hampers, but the price for which the crop was sold was not recorded. A conservative estimate of $2 net per hamper would indicate a net return of nearly $260.

In considering these samples of net returns it is important to remember that the industry of truck-crop growing is exceedingly speculative in its character owing to the great fluctuations in prices according to the season when the crop reaches the market, and to the uncertainties as to yields. It should also be noted that in certain years from two to three crops may be grown on the same land, although only one would be likely to reach a high market for vegetables.

The data available are much too meager to permit of any generalization as to the net annual value per acre of the land in a considerable number of cases for which rentals are known. The custard-apple and some of the intermediate soils rented for from $10 to $20 per acre. Nominal land values reported by renters ranged from $150 to $300 per acre. An official of the Southern Sugar Co. is authority for the statement that in the purchase of lands for the Florida East Coast Railway the average cost was $350 per acre for custard-apple soils, with an approximate range of from $80 to $400 per acre. In their present condition the value of the common run of land in the custard-apple area is probably lower than $350 per acre. On the other hand, if the entire area were well drained and protected against floods, the value probably would be somewhat higher. If a conservative figure of $250 be taken as the basis of estimate, and if it be assumed that there remain at least 10,000 acres of custard-apple soil not now in cultivation, it is indicated that a full utilization of this land under conditions of protection against flood might add at least two and one-half million dollars in land values, besides such other property values as might incidentally be created. Against this would have to be charged not only the cost of flood protection, but also the cost of such local drainage as would be necessary to render the land suitable for cultivation. It is more than probable that the average value of well-drained land protected from overflow would be considerably above $250 an acre.

The possibilities of sugar cultivation on the lands near the margin of the lake have already been discussed. If the high yields obtained in experimental plantings could be secured regularly under normal conditions of quantity production, there is reason to believe that a

large net return per acre would be realized. However, the industry has not been in operation long enough to permit the Southern Sugar Co. to supply adequate cost-accounting data. The company is counting on an average of 30 tons and has hopes that improved methods will permit the average to be increased to 40 tons per acre. As already pointed out, these expectations might be found to be excessively optimistic if certain diseases and other unfavorable conditions should develop.

The saw-grass area.—The foregoing discussion and rough estimates have dealt mainly with the custard-apple soil, which covers a very restricted area in comparison with the total area of saw-grass peat land in the Everglades. If the discussion for the former type of land involves much uncertainty by reason of lack of adequate data and experience with its cultivation, the basis for the discussion of the economic outlook for the saw-grass area is still less definite. Three or four years ago there was little prospect that it could be utilized at all. However, the results obtained from the use of copper sulphate and from other chemical treatments supply a very tangible ground for the hope that much of this area may be found suitable for intensive agriculture. Nevertheless, in spite of the promising results secured in the past year or two in the experimental utilization of this soil, its economic prospects are still involved in great uncertainty. If the expectations legitimately aroused by the recent experiments should prove justified, it is not improbable that the total land value of this territory would be largely increased in addition to enhanced property values that would be created. On the other hand, if the soil should be found not to respond permanently to practicable methods of treatment, its value would be negligible—indeed much lower than its present rating, which is based in large measure on speculative outlook.

Experiments at the Brown plantation during the past year or two have resulted in most satisfactory yields of truck crops, of which the following representative figures (Table 8) for single years in respect to improved crops have been supplied by the company.

TABLE 8.—*Yields on saw-grass lands of the Everglades*

Crop	Yield per acre
Peanuts	1,612 pounds of nuts and 1,900 pounds of hay to 2,300 pounds of nuts and 4,200 pounds of hay.
Potatoes	Winter crop, 150 bushels; spring crop, 260 bushels.
Sugarcane	31.7 tons.
Corn (shelled)	53 bushels.
Celery	722 crates.
Peppers [1]	7,689 pounds.[1]
Squash [1]	3,772 pounds.
Okra [1]	3,548 pounds.
Spinach [1]	10,740 pounds.
Peas [1]	2,146 pounds.
Cauliflower [1]	5,040 pounds.
Cabbage	11.2 tons.
Onions	279 bushels.
Carrots	550 crates (5 dozen bunches each).
Tomatoes	360.5 crates.
Beans [1]	300 hampers.
Beets	8 tons (bunched).
Lettuce	870 crates.

[1] Treatment not the most favorable for maximum yield.

Even assuming that the productivity of this land might be found to be permanently as great as would be suggested by these experi-

mental figures obtained under comparatively favorable conditions, it is clear that the market for winter vegetables might be glutted by the produce from the large area of peat lands available in the Everglades. Table 9 shows the relatively small acreage employed in the United States in producing the winter supply of important truck crops for eastern markets. The acreage required for these eight important crops is less than 5 per cent of the total area available in the Everglades drainage district. About 9 per cent of the total requirement comes from foreign countries, and if this were shut out by a higher tariff the area in this country might be expanded by about 20,000 acres without seriously affecting prices. Our population growth will permit a small increase, probably as much as 10 per cent during the next decade. There has been a considerable increase in the use of out-of-season vegetables, and it is conceivable that there may be some further increase even at present price levels. Lower prices would stimulate greater consumption but at reduced profits to growers.

TABLE 9.—*Number of acres required to produce winter vegetables shipped to important eastern markets, November, 1926–June, 1927* [1]

	Green beans	Celery	Cucumbers	White potatoes	Cabbage	Peppers	Eggplant	Tomatoes	Total area required for all vegetables	Per cent of total
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	
Florida	16,008	4,689	8,670	24,360	1,562	1,506	131	32,515	89,441	44.8
Other States	8,913	3,373	3,248	41,641	12,943	520	2	20,090	90,730	45.5
Imports	47	-------	51	706	-------	1,289	495	16,828	19,416	9.7
Total	24,968	8,062	11,969	66,707	14,505	3,315	628	69,433	199,587	100.0

[1] Based on data on carload shipments published in Graphic Charts, issued by Florida State Marketing Bureau. Converted to acreage on basis of average yield figures for Florida, published in Yearbook for 1928, United States Department of Agriculture.

In addition to the area of saw-grass peat which may be found available for truck crops in case present experimental methods of cultivation continue to prove successful, it should be remembered that within the Everglades district there is a large additional area of sandy lands and around the borders of the district other sandy or marl areas, which are characterized by climatic conditions as favorable to, or even more favorable than, those prevailing in the peat soils. These areas when utilized with heavy applications of fertilizers would increase enormously the quantity of truck crops brought to market.

It seems probable, therefore, that the full development of the area of saw-grass peat land must be dependent on other types of agriculture than truck crops. The experiments with sugarcane in saw-grass areas near Lake Okeechobee, as already indicated, are promising. If sugarcane could be grown economically throughout a considerable part of the peat land this would contribute greatly to the progress of the region, for the domestic consumption—which is extremely large—could absorb far more than the Everglades could produce. It is by no means clear, however, that sugarcane would enjoy the natural advantages in the interior portion of the Everglades, which appear to exist in the territory near the lake where the crop is favored by a somewhat higher temperature at critical periods.

The prospect for general farming also is very uncertain. The area appears to be adapted to a number of forage crops which produce a large volume per acre. These products, however, would most

certainly have to be marketed through livestock. The market for milk is excellent during several months of the year, but in the remaining months it might be found necessary to market milk in the form of butter, condensed milk, and other manufactured products. Whether this area could compete successfully in the production of these manufactured dairy products with the established dairy districts of other parts of the United States, is questionable. The high prices obtainable in the winter season might, however, be found to offset any disadvantage in the marketing of milk in other seasons, and it is not impossible that a type of farming might be developed successfully that involved the combination of marketing milk with truck-crop growing. It should be noted, however, that certain counties of the Everglades drainage district are still infested with the cattle tick.

In short, it is clear that the utilization of the saw-grass lands still is in an experimental stage and that rapid development should be postponed until some of the problems of utilization are definitely solved.

Land values prevailing in the area of the saw-grass peat are so speculative that they afford little basis for judgment as to the actual value of these lands. In 1908 the trustees of the International Improvement Fund sold Everglades land at $1.25 per acre. By 1910, as a result of drainage prospects, sales averaged $15 an acre and in 1913 averaged $15.45. From that time forward there has been a rapid speculative increase in land values as indicated by the fact that in 1926 sales of State lands in the area averaged $108.66 per acre. The average for 1928, however, was reported at $92.68.[3] Lands in the saw-grass peat area for right of way for the Florida East Coast Railway were reported to have averaged in cost about $50 an acre.

It should be noted that the foregoing prices refer to raw land which is subject to the general district tax and which still must bear the cost of additional drainage, both primary and secondary. The costs of reclamation are not extremely high—as compared for instance with the cost of some of the reclamation projects in the Western States. Engineers of the War Department estimate about $20 an acre as the probable cost of main drainage and flood control. It is estimated that it will cost about $30 per acre for secondary drainage in the Everglades when the run-off must be pumped from the district. In addition there will be the cost of operating the pumps which over a period of years would average from $3 to $4 per acre per year. If drainage costs are regarded as the principal charge against the land that must be met if profitable farming is to be carried on, those indicated would not appear to be prohibitive for the development of general farming, and certainly are low for truck farming on saw-grass land. If, however, the farmers were compelled to shoulder speculative values as is indicated by recent sales, and in addition the cost of drainage, a different complexion would be given to the possibilities of successful general farming.

Undoubtedly, in its level topography the area has a very great advantage from the standpoint of modern methods of agriculture. Progressive operators such as the Southern Sugar Co. and the Brown Corporation are finding it practicable to achieve a maximum of economy through the utilization of labor-saving machinery. The possibilities of mechanical agriculture, the drainage problems, the technological problems involved in the utilization of the soil, and the complexity of the problems of marketing, all appear to favor the relatively

[3] Biennial Report (1927–28), Everglades drainage district, pp. 65 and 76.

large-scale type of farming. On the other hand, there are in this area a considerable number of small truck farmers, many of whom are operating on rather unscientific and ineffective methods. Many of these people are merely taking the chance of a good crop and high prices and not a few of them are transients who will not reside permanently in the region. As already suggested, it may be found possible to develop a type of small-scale farming involving the combination of truck growing with dairying.

The future course of development is likely to be influenced in considerable measure by the present character of land ownership in the undeveloped areas. Officials of the drainage district have afforded the committee an analysis of the ownership of land in Palm Beach County.

Omitting tracts of less than 10 acres such as town lots and small suburban tracts, it is estimated that the area available for agriculture in that county is about 800,000 acres. This territory is distributed approximately as follows:

13,979 tracts from 10 to 20 acres; total, 210,000 acres.
2,510 tracts from 20 to 40 acres; total, 75,000 acres.
833 tracts from 40 to 80 acres; total, 50,000 acres.
286 tracts from 80 to 160 acres; total, 36,000 acres.
95 tracts from 160 to 320 acres; total, 24,000 acres.
107 tracts from 320 to 640 acres; total, 48,000 acres.
567 tracts of more than 640 acres; total, 357,000 acres.

Of the 567 tracts of 640 acres or more, 200,000 acres is held by the State; the remaining 157,000 acres is owned by about 15 large holders or groups of holders. In the Everglades as a whole the trustees of the Internal Improvement Fund owned 871,600 acres on December 31, 1928, and approximately 128,494 acres which had been sold subject to partial-payment contracts. The State school fund owned approximately 95,400 acres. Well-informed authorities on real estate conditions supplied information as to large holdings within the Everglades district. The instances mentioned are given in Table 10.

TABLE 10.—*Typical large land holdings in the Everglades district*

Total land in holding	Approximate amount of it which is muck or peat
300,000	100,000.
200,000	100,000.
175,000	160,000.
165,000	Very little.
100,000	Do.
70,000	70,000.
40,000	40,000.
30,000	30,000.
30,000	15,000.
15,000	Nearly all.
10,000–15,000	Do.
10,000	Peat or marl.

Large corporations such as the Southern Sugar Co. have found it difficult to acquire the ownership of extensive contiguous areas on account of the scattering character of land ownership, partly due to the operations some years ago of real-estate concerns which sold small tracts on a speculative basis. On the other hand, the existence of numerous large holdings held on a speculative basis is a condition of considerable consequence in the future development of the territory if that development is to take the form of small-scale farming.

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JUL 16 1936 Dr. Aughte
AUG 10 1936
JAN 9 1940
JUL 17 1939
MAY 20 1940 Wendzel
JUN 13 1940

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